PHYSICAL AND CHEMICAL CHARACTERISTICS OF MAIZE STOVER SILAGE

A. MIDAU[1], A. E. ONYIMONYI[1]*, I. D. MOHAMMED[2], C. AUGUSTINE[3] AND I. H. MALGWI[2]*

[1] *University of Nigeria, Nsukka, Department of Animal Science, Enugu State Nigeria*
[2] *University of Maiduguri, Department Animal Science, Borno State Nigeria*
[3]*Adamawa State University, Mubi Department Animal Production, Adamawa State, Nigeria*
**Correspondence::alexmidau@yahoo.com;08032160304.*

ABSTRACT

The research was conducted at the Livestock Teaching and Research Farm, Department of Animal Science, Adamawa State University, to determine physical and chemical characteristics of urea treated maize stover at different levels of urea inclusion incubated for 21 days. The colour/appearance, smell, texture, pH and temperature for urea treated maize stover were dark yellowish/brown colour in all the treatments an indication of good quality and normal color range for grass, cereal and maize silages. The mild sour smell in treatment M2 and sour smell in both M3 and M4 also shows that, there was normal lactic acid fermentation in the process, urea treated maize stover had leafy and soft texture in all the treated materials in M2, M3 and M4.The chemical composition of urea treated maize stover obtained ranged as follows; DM (80.52-90.10%), CP (5.7-12.8%), CF (34.6-41.5%), NDF (61.4-3.1%), ADF (42.3-46.6%), lignin (5.2-8.2%), EE (1.83-1.86%), Ash (8.2-13.8%), NFE (29.5-45.8%), Gross energy (18.8-23.9MJ/kg), Ca (2.2-6.6 g/kg), phosphorus (0.9-4.4 g/kg), K (11.4-12.8 g/kg), Na (0.15-0.33 g/kg), Mg (2.1-2.5 g/kg), Mn (107-122 mg/kg), Zn (13-26 mg/kg) and Cu (1.4-3.0 mg/kg). Urea treatment had significantly ($P<0.01$) increased the crude protein values from 5.7-12.8 and significant ($P<0.05$) increase on Ash, Na, Calcium, Copper, gross energy, sodium, phosphorus and zinc. There was also significant ($P<0.05$) decrease in NDF, ADF, lignin, K, Mn, and Cu across the treatments.

Keywords: Physical, chemical, maize stover, silage, urea

INTRODUCTION

Farmers generally utilize these crop residues for livestock feeding without considering the use of any of the existing improvement technologies. This situation may be reversed by adapting known technologies that have been developed for local conditions, such as urea treatment and legume supplementation. In the presence of a dynamic market system, livestock production in a crop/livestock system could thus be intensified and made profitable for small-scale farmers (Preston and Leng, 1987). Field observations show that maize stover is the most abundant residue in smallholder crop/livestock production systems, but are poorly handled and stored. The most commonly observed methods of handling the maize stover are harvesting and either stacking in the field for gradual collection as required for feeding, storing under trees or in the home compound usually in the open and very rarely in roofed barns. This leads to loss of considerable amounts and nutrients due to weathering and leaf shattering (Methu, 1998). Improper management and storage methods drastically reduce the proportions of cereal stover available as feed as well as the efficiency of utilization (Promma *et al.,* 1994). The nutritive value of crop residues such as maize stover, has been increased by alkali treatment and/or nitrogen (N) supplementation (Chandrasekharaiah *et al.,* 1996). Urea is the preferred alkali for treatment due to its low cost and ease of handling (Sahnoune *et al.,* 1991) and the extra N it supplies increases the crude protein (CP) concentration of crop residues (Mc Donald *et al.,* 1995). This study was conducted to determine chemical composition of urea treated maize stover at different levels of inclusion. Such information can be used in developing utilization strategies and formulation of improvement packages.

MATERIALS AND METHOD

Experimental Site

The experiment was carried out at the Livestock Teaching and Research Farm Yola, Adamawa

State University, Nigeria. The location as described by (Adebayo and Tukur, 1999).

Feed Preparation

Maize Stover were chopped to moderate sizes about 2-3cm before chemical treatment, the feed (M2, M3 and M4) were incubated in 3 underground constructed pit of 2mx1mx1m dimension with a capacity of 200-300 kg of urea treated maize as follows;

Chemical treatment of Maize Stover: the maize Stover was treated as follows;

i. 100kg of **Maize Stover** + 0kg urea (M1)

ii. 100kg of **Maize Stover** + 4kg urea + 50 liters of water. (M2)

iii. 100kg of **Maize Stover** + 5kg urea + 50 liters of water. (M3)

iv. 100kg of **Maize Stover** + 6kg urea + 50 liters of water. (M4)

RESULT AND DISCUSSION

Silage Evaluation

The colour/appearance, smell, texture, pH and temperature for urea treated maize stover were presented in the Table 1 above, urea treated maize stover had dark yellowish/brown colour in all the treatments is an indication of good quality and normal color range for grass, cereal and maize silages (FAO, 2000; Kaiser and Blackwood, 2004; Amodu, *et al.*, 2014). The mild sour smell in treatment M2 and sour smell in both M3 and M4 also shows that, there was normal lactic acid fermentation in the process, urea treated maize stover had leafy and soft texture in all the treated materials in M2, M3 and M4. Amodu *et al.* (2014) in his research on Evaluation of Maize Accessions for Nutrients Composition, Forage and Silage Yields in SHIKA Zaria also reported that, there was leafy appearance with soft texture, light yellowish brown colour with an aroma mild pleasant sour milk smell, he also reported pH, 3.9 for West Atlantic seed Alliance (WASA1) and 4.1 for local variety from Shika tagged (SHIMAZ) and temperature 29.0 and 31.0°C for West Atlantic seed Alliance (WASA1) and local variety from Shika tagged (SHIMAZ) respectively. Kaiser and Blackwood (2004) also made an assertion that the good fermented maize silage should be leafy, soft to touch, yellowish-brown, mild pleasant and sour smell. The pH values obtained M3 (4.2) and M4 (4.3) in this study is within the recommended range of 3.7-4.2 stated by Kaiser and Blackwood (2004) and Kung and Shaver (2001) for maize silage, while pH for M2 (3.4) was lower than the recommended levels. Amodu *et al.* (2001) also observed a higher range of (4.3-4.5) pH for three accessions of pearl millet in SHIKA Zaria. The temperature obtained from the silage in all the treatment were M2 (36.2°C), M3 (37.6°C) and M4 (37.5°C), these agreed with Adesogan and Newman (2008) that silage temperatures should not be more than 37.7°C which encourages good silage fermentation, because higher temperatures reduce the quality of the silage, enhance protein degradation and reduce rapid pH decline for an efficient degradation.

Proximate Composition of the Experimental Diets

The chemical composition of urea treated maize stover are shown in Table 2 below, the values obtained ranged as follows; DM (80.52-90.10%), CP (5.7-12.8%), CF (34.6-41.5%), NDF (61.4-3.1%), ADF (42.3-46.6%), lignin (5.2-8.2%), EE (1.83-1.86%), Ash (8.2-13.8%), NFE (29.5-45.8%), Gross energy (18.8-23.9MJ/kg), Ca (2.2-6.6 g/kg), phosphorus (0.9-4.4 g/kg), K (11.4-12.8 g/kg), Na (0.15-0.33 g/kg), Mg (2.1-2.5 g/kg), Mn (107-122 mg/kg), Zn (13-26 mg/kg) and Cu (1.4-3.0 mg/kg). Urea treatment had significantly ($P<0.01$) increased the crude protein values from 5.7-12.8 and significant ($P<0.05$) increase on Ash, Na, Calcium, Copper, gross energy, sodium, phosphorus and zinc. There was also significant ($P<0.05$) decrease in NDF, ADF, lignin, K, Mn, and Cu across the treatments. Urea-treatment increased CP content of the stover which is in accordance with previous studies (Guo, 2000; Dawit and Solomon, 2008; Getahun, 2014) that noted improved content of CP as a result of urea treatment of crop residues. Urea ammoniation of poor quality roughages increases palatability, digestibility and adds a significant amount of nitrogen into the straw (Ranjahn, 2001; Misra *et al.*, 2006; Girma and Goetsch, 2007). Masimbiti (2001) supported the idea that urea treatment tends to increase CP and Metabolizable energy (ME).

Similarly, urea treatment decreased NDF content in this study which is in agreement with the previous reports by (Fitsum, 2015; Rehrahie and Ledin, 2004; Misra *et al.*, 2006; Weldegebreil, 2007). Bareeba and McClure (1996) also showed that urea treatment of maize stover changes DM (33.7 to 34.8%), CP (5.6 to 14.2%), NDF (71.1 to 70.7%), acid detergent fiber (ADF) (45.5 to 46%) and ash (10.5 to 10.3%). Similarly, Weldegebriel (2007) showed that urea treatment of maize stover increased the CP (2.9 to 4.4%), total DM (11 to 30.8%), organic matter (OM) (13 to 30.7%), ADF (487 to 507 g/kg DM) and acid detergent lignin (ADL) (43 to 48%). Hirut *et al.* (2011) reported that urea treatment of Maize stover increased the CP (5.8 to 7.7%) and decreased contents of NDF (86.6 to 73.9). According to Tesfaye *et al.* (2005) Crude protein (CP) content of the urea-molasses treated maize stover was close to 3.8 folds higher than that of the untreated stover. The reduction in NDF is attributed to the softening effect of urea on the hemicellulose fraction and subsequent removal from cell wall constituents (Tesfaye *et al.*, 2005). The ADF contents also slightly decreased form 46.6 to 42.3 with urea treatment, the increase in ADF content after fermentation is in contrast with the report of Phiri *et al.* (2007) who reported that ensiling had no effect on ADF. On the other hand, Nkosi *et al.* (2011) reported that ensiling decreased both NDF and ADF contents. In this study, NDF concentration of the stover was more affected by urea treatment than ADF probably because hemicellulose is most sensitive to delignification, Woyengo *et al.* (2014) also reported that treatment of stover significantly improved DM, OM, CP, NDF and cellulose digestibility of the stover. Alkali treatment is reported to cause swelling of cell walls (which allows greater diffusion of cellulolytic enzymes), disruption of bonds between lignin and cell wall carbohydrates (which increases the availability of the carbohydrate for degradation by rumen microorganisms) and solubilisation of some of hemicellulose and CP (Theander, 1981; Oosting, 1993; Van Soest, 1994). In addition, urea treatment provides extra N, which increases rumen microbial activity (Van Soest, 1994) and hence increases digestibility (Tuen *et al.*, 1991; Oliveros *et al.*, 1993; Shashi-Saijpaul *et al.*, 1996). The result of this study was in agreement with that obtained by Guo (2000) and Getahun (2014) but in disparity to the reports of Rehrahie and Ledin (2004) who reported increased concentration of ADF and in urea treated straw. The CP contents obtained in this study was higher than the value 9.98 recorded by (Sekhonyana and Fulpagare, 2015) the CP was lower than the value 24.27 treated with 5% urea and 13.59 treated with 4% reported by (Egbu, *et al.*, 2015 and Babawuro and kibon, 2013) a higher values 14.9 and 14.2% was also report by Fall *et al.* (1987), Bareeba and McClure (1996) respectively, these variations in CP content might be inline with observation by Sundstol and Coxworth (1984) who reported that two-thirds of the ammonia generated is usually evaporated (volatile nitrogen loss) to the environment in the course of urea treatment and until feeding to the animals, which is also another factor responsible for lower CP content of the treated stover; similar values was reported by Ibrahim *et al.* (2003). The dry matter in the treated diets M2, M3 and M4 was below the value 88.30% reported by Babawuro and Kibon (2013). The ash content in maize stover 13.8% was within the range reported by (Nguyen, 2004) and this resume probably an indication of high concentrations of minerals as reported by (Fall, 1990). In a similar experiment; the increase in CP content of the stovers as a result of urea treatment was supported by (Getahun, 2006).

REFERENCES

Adebayo A.A and Tukur A.K (1999). *Adamawa State in Maps*. Published by Paraclete Publishers Yola, Adamawa State.

Amodu, J. T. Akpensuen T. T., Dung, D. D, Tanko, R. J., Musa, A.,. Abubakar, S.. Hassan, A, M. R, Jegede, J. O and I. Sani (2014) Evaluation of Maize Accessions for Nutrients Composition, Forage and Silage Yields. *Journal of Agricultural Science* Vol. 6, No. 4.

FAO (2000) Silage Making in the Tropics with Particular Emphasis on Smallholders, paper 161, Rome Italy.

Fitsum A. (2015). Effects of urea or urea molasses treatment on Feeding value of maize stover for hararghe highland Sheep a Thesis Submitted to the School of Graduate Studies (School of Animal and Range Science) Haramaya University.

Getahun Kebede, (2014). Effect of wheat straw urea treatment and leucaena leucocephala foliage hay supplementation on on intake, digestibility, nitrogen balance and growth of lambs. International Journal of Livestock Production, 6 (4): 88-96

Girma Abebe and Goetsch, A.L. (2007). Urea-ammonia treatment of low quality roughages. In: Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), 2007. Technical bulletin No. 2. In Fitsum, 2015.

Hirut Y, Solomon M and Mengistu U. (2011). Effect of concentrate supplementation on live weight change and carcass characteristics of Hararghe Highland sheep fed a basal diet of urea treated maize stover. Livestock Research for Rural Development, 23 (12).

Methu, J. N., 2003. Testing and promoting silage making technologies in the smallholder dairy farmers in Kenya. Quarterly report. Land O' Lakes Inc.

Misra A K. Mehra U. R. and R.S. Dass, (2006). Assessment of feeding urea ammoniated wheat straw on growth performance feed intake and nutrient utilization in cross bred calvesreared under stall fed or grazing condition. Livestock research for rural development. Volume, 18 No.11. Retrieved November 1, 2008, from http://www.lrrd.org/lrrd186/11/misr18164.htm

Preston, T.R. and R.A. Leng, (1981). Utilization of tropical feeds by ruminants. In: Digestive physiology and metabolism in ruminants (Eds. Ruschebush and Thivend). London, MPA Press Ltd.

Promma, S., Tasaki, I., Cheva-Isarakul, B. & Indratula, T., 1994. Stabilization with sulfuric acid of the Crude Protein in Urea-treated Rice straw. Australasian Journal of Agricultural Science, 7: 481-486.

Ranjhan, S.K. (2001). Animal Nutrition in the Tropics. 5th ed. New Delhi press. 76-84 p.

Tesfaye A. (1999). The Role of Crop Residues as Livestock Feed Resources in Semiarid Areas of Adamitulu District, Ethiopia. An MSc Thesis Presented to the University of Nairobi, Kenya. 90pp.

Table 1. Physical characteristics and pH of Maize Stover ensiled at different levels of urea incubated for 21 days.

Parameters	Treatments		
	M2 (4kg urea)	**M3 (5kg urea)**	**M4 (6kg urea)**
Colour/appearance	Dark yellowish/brown	Dark yellowish/brown	Dark yellowish brown
Smell	Mild sour smell	Sour smell	Sour smell
Texture	Leafy/Soft	Leafy/Soft/firm	Leafy/Soft/firm
pH	3.40	4.20	4.30
Temperature (°C)	36.20	37.60	37.50

Table 2 Proximate composition of urea treated and untreated maize stover

PARAMETERS	M1	M2	M3	M4	SEM
DM (%)	90.10^a	81.12^b	80.55^b	80.52^b	0.3008
CP (%)	5.70^c	12.80^a	12.80^a	12.70^a	0.3295
CF (%)	41.50^a	34.60^b	34.60^b	34.70^b	0.4320
NDF (%)	73.10^a	61.60^b	61.40^b	61.40^b	1.0120
ADF (%)	46.60^a	42.40^b	42.30^b	42.30^b	0.4955
Lignin (%)	8.20^a	6.30^b	5.20^c	5.20^c	0.3085
EE (%)	1.86^a	1.84^a	1.83^a	1.83^a	0.0188
Ash (%)	8.20^c	12.50^b	13.60^a	13.80^a	0.4947
NFE (%)	32.84^c	19.38^c	17.72^d	17.50^d	0.4288
Energy (MJ/kg)	18.10^b	23.40^a	23.70^a	23.90^a	0.3464
Calcium (g/kg)	2.20^c	4.30^b	6.60^a	6.50^a	0.1683
Phosphorus (g/kg)	0.90^d	2.30^c	4.10^b	4.40^a	0.0926
Potassium (g/kg)	12.80^a	12.10^{ab}	11.60^b	11.40^b	0.3100
Sodium (g/kg)	0.15^c	0.14^c	0.33^b	0.32^b	0.0009
Magnesium (g/kg)	2.50^a	2.30^b	2.30^b	2.10^c	0.0842
Manganese mg/kg)	122.00^a	119.00^b	110.00^c	107.00^d	0.9636
Zinc (mg/kg)	13.00^d	17.00^c	24.00^b	26.00^b	0.9258
Copper (mg/kg)	3.00^b	2.60^b	1.80^c	1.40^c	0.2126

a,b,c,- Row means with different superscripts are either significant at $P<0.05$ or highly significant at $P < 0.01$; SEM (Standard Error of Mean).