

BAP -15

Quality Characteristics and Chemical Composition of Ensiled Maize Stover with or without Additives

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Abstract

This study was carried out to determine the effect of additives on quality characteristics and chemical composition of ensiled maize stover. The maize stovers were ensiled with three energy additives (molasses, honey and sugar) in four treatments as A (maize stover only) control, B (maize stover + molasses), C (maize stover + honey) and D (maize stover + sugar) for 15 days. Quality characteristics and chemical composition were determined. The silage was characterized by greenish-yellow colour, fruity and pleasant odour, firm texture. The silage pH and temperature (°C) ranged from 3.44 - 3.52 and 26.20 - 26.40°C. The fibre fractions: neutral detergent fibre, (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), Hemicellulose and Cellulose were similar across the treatments. CP (Crude protein) was similar among the treatments except for silage with sugar that was significantly different from fresh maize stover. Ether extract (EE) was similar across the silages and fresh maize stover while crude fibre (CF) was also similar except for treatment B which was significantly lower than treatments A, C and D. Similarly, ash, organic matter (OM) and carbohydrate (CHO) composition are similar among the silages. NFE (Nitrogen Free Extract) was similar among treatments A, C and D, except for treatment B. The findings of this study indicate that the ensiled maize stover without additive (control) has similar quality characteristics with those ensiled with additives. Therefore, it was concluded that maize stover was able to preserve well without additive.

Keywords: silage, maize stover, additive, chemical composition, quality.

Introduction

Recently, one of the major challenges facing cattle farmers in Nigeria is inadequate forages to sustain the animal and this usually results to an incessant clash between farmers and herdsmen which had led to the death of many farmers and lots of crops and animals. There is decline in supply and quality of herbage for livestock during the dry season. The concern of Animal Scientists is feed production and utilisation in the dry season to stem the cyclic pattern of weight gain and loss between seasons (Sowande *et al.*, 2008). Consequently, there is need for us to source for alternative feed such as crop residues in order to complement inadequate available pasture for ruminant animals. Crop residues constitute an important feed resource for animals, especially in the dry season. With increasing human population, cropping land is expanding leading to increase production of crop residues. However, this is associated with decreasing land availability for fodder production, thus forcing crop residues to contribute significantly to the livestock feed resources pool. In Nigeria, large quantities of crop residues such as cereal straw and stover, legume crops, straw and hulls, sugar cane tops, cassava leaves and sweet potato vines are left in the field and/or harvested for livestock feeding (Amuda *et al.*, 2017). However, these crop residues are generally poorly utilised as animal feed each year because small-scale farmers lack the technical knowledge on how best to use them (Methu, 2003).

Field observations show that maize stover is the most abundant residue in smallholder crop production systems, but poorly handled and stored (Syomiti, *et al.*, 2009). Ensiling has been reported to effectively conserve forages and fodder crops (Babayemi, 2009). The ensiling of crop residues and by-products is a simple and appropriate method of conservation. It is the most-effective way to improve animal feed resources through the national use of locally available agricultural and industrial by-products likely to be available to small-scale farmers at the village level. A concrete way of addressing the problem of feeding ruminant livestock in the dry season is using silage or hay. Silage is a sustainable means of supplementing poor quality feed for ruminants in the dry season. Silage making can be considered the most effective way of preserving green forages over hay making, if all essential steps of silage making are followed. Silage making is less dependent on weather.

This study was undertaken to document effects of different additives on silage quality characteristics and chemical composition of ensiled maize stover.

Materials and Methods

Freshly harvested green maize stovers were collected from Practical Year Training Programme Farm University of Ibadan. Harvesting was done in the month of July and the samples were collected in batches. Harvested maize stovers were chopped into 3 – 5cm pieces size (for easy compaction). Thereafter, the chopped materials were wilted under shade for 24 hours on the concrete floor and then weighed, mixed and divided into equal portions (1kg) for the application of four experimental treatments. Each additive was added at 5% level treatment. Treatment A: Maize Stover only (MS), Treatment B: Maize Stover + Molasses (MS+M); Treatment C: Maize Stover + Honey (MS+H); Treatment D: Maize stover + Sugar (MS+S). The control forage was ensiled without the additive. All were replicated five times in a completely randomised design. Ensiling was done by rapid compaction of the material (to eliminate air) into the silos, sealed up and compressed with the small sandbag of 2kg. Fermentation period was 15 days. The pH, temperature, colour, smell, texture and moisture content were determined (Bababyemi *et al.*, 2009 and Amuda *et al.*, 20017).

The samples were ground in the laboratory with hammer mill of 1mm sieve and subjected to chemical analysis as described by AOAC (2000). Fibre fractions NDF, ADF and ADL were assayed by the method of Van Soest *et al.*, (1991). Hemicellulose was calculated as the difference between NDF and ADF and cellulose as the difference between ADL and ADF (Rinne *et al.*, 1997).

The experimental design used was Completely Randomised designed (CRD) and data collected were subjected to analysis of variance (ANOVA) using the procedure of SAS (2003).

Results and Discussion

The physical quality characteristics of the ensiled maize stover as reflected in terms of colour, texture and odour are shown in table 1a, while table 1b shows the pH, temperature, dry matter (DM) and moisture content (MC) of the silages. The colour of MS silage (control) and MS silages with additives was greenish-yellow. In terms of texture, all the silages were firm. Also, the odours were similar among the four treatments as the silages were characterized by fruity and pleasant and alcoholic odour. The colours of the silages were close to the original colour of maize stover which was an indication of well-preserved silage as reported by Amuda *et al.*, (2017) and Oduguwa *et al.*, (2007). The pH ranged from 3.44 in treatment B (MSH) to 3.52 in treatment C (MSS) and D (MSS) respectively. The pH obtained in this study is within the range of 3.48 -3.70, 3.2 - 3.8 and 3.1-3.6 reported by Amuda *et al.*, (2017), Fasina, (2012) and Oduguwa, *et al.*, (2007).

Table 1.a: Physical Quality Characteristics

Silage treatments	Quality indicators			
	Mouldness	Colour	Texture	Odour/smell
MS only (Control)	No mould	Greenish Yellow	Firm	Fruity and Pleasant
MS + Molasses	Slightly mould	Greenish Yellow	Firm	Fruity and Pleasant
MS + Honey	No mould	Greenish Yellow	Firm	Fruity and Pleasant
MS + Sugar	Slightly mould	Greenish Yellow	Firm	Fruity and Pleasant

MS = Maize Stover

Table 1.b: Silage Quality Characteristics

Quality Characteristics	MS Only (Control)	Treatments			SEM
		MS + M	MS + H	MS + S	
pH	3.48	3.52	3.44	3.52	0.03
Temp. (°C)	26.40	26.20	26.20	26.40	0.09
Dry Matter (%)	31.42 ^b	35.47 ^{ab}	40.65 ^a	31.85 ^b	3.31
Moisture Content (%)	68.58 ^a	64.53 ^{ab}	59.35 ^b	68.15 ^a	3.31

a,b = Means on the same row with different superscripts are significantly (P < 0.05) different

A - Control (Ensiled Maize stover without additives).

B - MS+M (Ensiled Maize stover + Molasses)

C - MS+H (Ensiled Maize stover + Honey)

D - MS+S (Ensiled Maize stover + Sugar)

SEM: Standard Error of Mean

The temperature range of 26.20 – 26.40°C of all the silages was below 27°C and indicated well-preserved silage. Generally, temperature is one of the essential factors affecting silage colour. The lower the temperature during ensilage, probably the less will be the colour change (Adesogan and Newman, 2010). Dry matter (DM) of the silage ranged from 31.42 to 40.65%. Additives are used to improve silage preservation by ensuring that lactic acid bacteria dominate the fermentation phase. Dry matter of silage MS+M and MS+H were significantly higher than MS (control) and MS+S which could be attributed to the addition of molasses and honey to the silages. This probably the most important benefit of additives such as molasses to improve DM in early-cut crops when the moisture content is high and where effluent is lost to the silage through seepage. Tropical grasses have been successfully ensiled when supplemented with additives.

Crude Protein (CP), Crude Fibre (CF), ash, Organic Matter (OM), Ether Extract (EE), Nitrogen Free Extract (NFE) and Carbohydrate (CHO) of the ensiled maize stover (MS) and unensiled stover are presented in Table 2. Crude protein ranged from 7.53% in (MS+S) to 9.27% (MS-fresh/unensiled). Crude fibre (CF) ranged from 29.31.0% in (MS+M) to 32.52% (MS only) control. The CP, EE, Ash, CHO and OM were similar across the treatments, however CF was significantly ($p < 0.05$) different such that it was lowest in MS+M silage (29.31%) and highest in MS silage only (control) (35.52%). NFE ranged from 49.42% (MS fresh) to 54.04% in (MS+M) silage. Nitrogen free extract (NFE) of MS+M was significantly ($p < 0.05$) different from other treatments.

Table 2: The proximate composition of Fresh and Ensiled Maize Stovers

Nutrient (%)	Unensiled	MS Only (Control)	MS+M	MS+H	MS+S	SEM
Crude protein	9.27 ^a	7.86 ^{ab}	8.22 ^{ab}	7.84 ^{ab}	7.53 ^b	0.78
Crude fibre	32.27 ^a	32.52 ^a	29.31 ^a	32.22 ^a	32.27 ^a	1.56
Nitrogen free extract	49.42 ^b	50.96 ^b	54.04 ^a	51.54 ^b	51.04 ^b	1.93
Ash	7.32 ^a	6.85 ^b	6.76 ^b	6.57 ^b	6.92 ^b	0.32
Ether extract	1.72 ^a	1.82 ^a	1.68 ^a	1.83 ^a	2.25 ^a	0.26
Carbohydrate	81.69 ^b	83.47 ^a	83.35 ^a	83.76 ^a	83.30 ^a	0.94
Organic Matter	92.68 ^b	93.15 ^a	93.24 ^a	93.43 ^a	93.08 ^a	0.32

a, b = Means on the same row with different superscripts are significantly ($p < 0.05$) different

The fibre detergent fractions of ensiled maize stover were presented in Table 3. All the fractions were similar across the treatments. The NDF (total cell walls) ranged from 69.10% (MS+H) to 70.02% (MS+S) While the ADF (lignocelluloses) ranged from 56.53% (MS+H) to 59.48% (MS+M) and the ADL ranged from 14.72% (MS+S) to 16.36% (MS+M). Hemicellulose and cellulose values ranged from 10.23 -12.54% and 41.30 - 43.84% respectively. The hemicellulose and cellulose composition of fresh/un-ensiled and silages were similar across the treatments. The result obtained in this study is similar to reports of Amuda *et al.* (2017), where maize stover with and without additives was ensiled for 30 days.

Table 3: Fibre Fractions of Fresh and Ensiled Maize Stover

Fibre Fractions	Unensiled MS	MS only (control)	MSM	MSH	MSS	SEM
NDF	69.23 ^a	69.82 ^a	69.71 ^a	69.10 ^a	70.02 ^a	0.46
ADF	57.50 ^a	59.11 ^a	59.48 ^a	56.53 ^a	58.56 ^a	1.40
ADL	15.94 ^a	16.03 ^a	16.36 ^a	15.26 ^a	14.72 ^a	0.76
Hemicellulose	11.73 ^a	10.71 ^a	10.23 ^a	12.54 ^a	11.59 ^a	1.05
Cellulose	41.52 ^{ab}	43.08 ^{ab}	43.12 ^a	41.27 ^{ab}	43.84 ^b	1.29

a, b = Means on the same row with different superscripts are significantly ($p < 0.05$) different

Conclusion and Recommendations

From the findings above, ensiled maize stover with and without additives have similar quality characteristics and chemical composition. Therefore it was concluded from this study that, maize stover can be

preserved without additives provided all the steps of silage making processes are followed and this will reduce the cost of production. Livestock farmers should be educated on the techniques on silage production in order to convert abundantly available maize stover (crop residue) to useful products. Consequently, this will alleviate the menace of dry season feeding and curtail vicious cycle of lost weight-gain.

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