SILAGE QUALITY AND FORAGE YIELD OF SWEET CORN STOVER FORTIFIED WITH DIFFERENT ENERGY SOURCES IN SHIKA.

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ABSTRACT

This study was conducted to evaluate the silage quality and nutritional composition of sweet corn stover fortified with different energy sources. The experimental design was complete randomized design with five treatment (1: control without fortification, 2: fortified with wheat offal, 3. fortified with maize offal, 4. fortified with rice bran and 5. fortified with molasses replicated three times. The result revealed that temperature of 22.33ºC for silage fortified with rice bran and molasses was significantly (P<0 .05) higher than those fortified with wheat offal, maize offal and the control (20.50, 21.66 and 21.50ºC), respectively. The pH of the silage fortified with wheat offal (3.50) and maize offal (3.95) was lower (p < 0.05) than those fortified with molasses (4.88), rice bran (5.04) and the control (5.85). Wheat and maize offal fortified silages had sweet aroma while those fortified with molasses had pleasant aroma. The texture for all the treatments were coarse. The colour was deep brown for the control and molasses fortified silages while wheat offal, maize offal and rice bran had light brown colour. The highest (P<0.05) fresh forage (6.22 and 6.23 t/ha) and dry matter yield (2.23 and 2.29 t/ha) were obtained in sweet corn stover silage fortified with wheat and maize offal, respectively. It can therefore be concluded from the result of this study that ensiled sweet corn stover with wheat offal or maize offal had better temperature, lower pH with sweet pleasant aroma.

Key words: Sweetcorn, Silage, Fortified, Stover.

DESCRIPTION OF PROBLEM

Silage is a critical component of animal feed, particularly in dairy and livestock farming, as it serves as a preserved form of forage that helps sustain animals during periods when fresh forage is unavailable, such as critical months. Silage is typically made by harvesting forage crops at their peak nutritional value and then storing them in an anaerobic environment, such as a silo, pit, or bale. The most common crops used for silage are maize (corn), alfalfa, and various grasses (Muck, 2018). The process of ensiling involves cutting and compacting the plant material to remove air, thereby encouraging the growth of lactic acid bacteria. These bacteria ferment the sugars in the plant material to produce lactic acid, which lowers the pH and inhibits the growth of spoilage microorganisms.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at Samaru College of Agriculture Teaching and Research Farm (livestock section). Division of Agricultural College, Ahmadu Bello University, Zaria. The trial was conducted during 2024 dry season. The site has a tropical savannah climate, with a mean annual rainfall of 1,000 mm and a mean annual temperature of 28°C. The soil at the site is a sandy loam with a pH of 6.5.

Experimental Design

The design of the study was a completely randomize design (CRD) with five treatments replicated three times. The treatments include T1 control, T2 Wheat offal. T3 Maize bran, T4 Rice bran and T5 Molasses.

Ensiling Procedure and Evaluation

The corn stem and leaves were thoroughly chopped and mixed in a ratio of 90:10 with the respective fortifying energy sources namely

wheat offal, maize bran, rice bran and molasses to enhance fermentation and quality of the material. The mixture was put in a bottle container compressed to remove air and sealed. The bottle was stored for 21 days for the fermentation process to take place. At the end of 21 days fermentation period, samples of ensiled materials were taken from each replicate for physical characteristics and chemical evaluation.

Data Collection

Data on silage quality were collected which include Temperature, Aroma, Texture, pH and Colour also yield parameters were also taken this include Fresh weight and Dry weight to determine the dry matter yield of the silage.

Data Analysis

Data collected at the end of the experiment was analyzed using the procedure of the statistical analysis system (SAS 2005). Significant differences among treatment means were compared at 5% probability level using Duncan Multiple Range Test in the SAS Package.

Model for Experiment:

$Y_{ij} = \mu + T_i + E_{ij}$

Where:, Y_{ij} = Record of observations.

μ = Population means.

T_i = Effect of treatment (i= 1, 2, 3, 4 and 5).

E_{ij} = Random error.

RESULT AND DISCUSSION

Physical Characteristics of sweet corn stover silage fortified with different energy sources

Different energy sources have significant (P< 0.05 %) effect on physical characteristics of sweet corn stover silage. The result revealed that temperature of 22.33^{o}C for silage fortified with rice bran and molasses was significantly (P<0 .05) higher than those fortified with wheat offal, maize offal and the control (20.50, 21.66 and 21.50^{o}C), respectively. The pH of the silage fortified with wheat offal (3.50) and maize offal (3.95) was lower (p < 0.05) than those fortified with molasses (4.88), rice bran (5.04) and the control (5.85). Wheat and maize offals fortified silages had sweet aroma while those fortified with molasses had pleasant aroma. However, the control, with no fortification and the rice bran fortified silages had putrid aroma. The texture for all the treatments were coarse. The colours were deep brown for the control and molasses fortified silages while wheat offal, maize offal and rice bran had light brown colour.

Table 1. Physical characteristics of sweet corn Forage Silage fortified with different energy sources

Treatments	Control	Wheat offal	Maize offal	Rice bran	Molasses	SEM	Range
Temperature (^{O}C)	21.50^{ab}	20.50^{b}	21.66^{ab}	22.33^{a}	22.33^{a}	0.042*	(20-30)
pH	5.85^{a}	3.50^{c}	3.95^{bc}	5.04^{ab}	4.88^{ab}	0.046*	(3.8-4.2)
Aroma	Putrid	Sweet	Sweet	Putrid	Pleasant		
Texture	Coarse	Coarse	Coarse	Coarse	Coarse		
Colour	Deep brown	Light brown	Light brown	light brown	Deep brown		

^{abc}means with different superscripts along the row within treatment differed significantly (P<0.05); SEM= Standard Error of the Mean. * = Significantly different means; ns = Not significant

Forage yield of sweetcorn stover silage fortified with different energy sources

The forage yield of sweet corn stover silage fortified with different energy sources is presented in table 3. The highest (P<0.05) fresh forage (6.22 and 6.23 t/ha) and dry matter yield (2.23 and 2.29 t/ha) were obtained in sweet corn stover silage fortified with wheat and maize offal, respectively. While the least values of 6.04 t/ha and 1.86 t/ha for fresh weight and dry weight, respectively were observed in the control treatment.

Table 2. Forage Yield of Sweet corn Silage Fortified with different energy sources

Parameters	Control	Wheat offal	Maize offal	Rice bran	Molasses	SEM
Fresh silage yield (t/ha)	6.04^{a}	6.22^{a}	6.23^{a}	5.76^{a}	6.17^{a}	0.156
Dry matter yield (t/ha)	1.86^{a}	2.23^{a}	2.29^{a}	2.05^{a}	2.17^{a}	0.063

^{abc}means with different superscripts along the row within treatment differed significantly (P<0.05); SEM= Standard Error of the Mean. * = Significantly different means; ns = Not significant

Discussion

The pH values recorded for most of the silages were within the range of 4.50-5.50 reported and classified as good silage by Ojo *et al*. (2018). When compared to values obtained by Veriato *et al*. (2018) determined the fermentation pattern of the corn silage found pH values varying between 3.69 and 4.58. The stability of pH in silage is due to interactions between dry matter concentration, the buffer capacity of the forage, soluble carbohydrate and lactate concentrations, and anaerobic conditions (Barker *et al*., 2020). In this way, the silages of the differently fortified sweet corn with wheat offal and maize offal have reduced pH values and can be classified as of good quality. A pH higher than 4.5, there will be a variation range of microorganisms, with conditions for the development of most bacteria, including pathogens, moulds and yeasts. The temperature obtained in this study is within the optimal temperature range for the dominant lactic acid bacteria involved in the silage fermentation process which is generally considered to be between 20 and 30 °C (Liu *et al*., 2024). Deviations from this range, whether higher or lower, can affect their growth and reproduction, subsequently influencing the fermentation quality of silage feed (Zhou *et al*., 2016). However, it is important to note that the optimal temperature for silage may vary depending on the type of material being used. Studies have shown that the optimal temperature of corn stalk silage is 25 ℃, while the optimal temperature range of whole corn silage is 20–25 ℃ (Kim *et al*., 2006; Li *et al*., 2019). The stover silage fortified with wheat offal, maize offal and molasses have sweet pleasant aroma.

The good silage colours are light brown and yellowish with a sour smell (Anas *et al*., 2024). Good quality silage is indicated by bright and brownish green, depending on the material (Yerima *et al*., 2015). Based on the result of this finding, silage colour fell into the light brown in wheat offal, maize offal and rice bran additives, and deep brown colour was observed in the control and silage fortified with molasses. Good-quality silage is one whose texture is not smooth, watery, mouldy, or lumpy (Anas *et al*., 2024). The texture quality obtained is in the medium category, coarse, throughout the treatments.

Forage Yield

The result of this study proves that the fermentation process occurs in good conditions. This is indicated by the same value of silage DM yield or relatively the same value between wheat offal, maize and molasses fortified silage. The DM yield is in the range of 2.05 -2.29 t/ha is considered to be influenced by the pH level of silage which is classified as an ideal pH so that the ensilage process will occur normally. Faster of pH decline, more silage dry matter will be maintained during the fermentation process Dong *et al*. (2022). This fell within the range of 2 – 50 DM t/ha reported by García-Chávez *et al*. (2022) in a systematic review.

CONCLUSION AND APPLICATION

It can therefore be concluded from the result of this study that fortifying sweet corn stover silage with wheat offal or maize offal had lower temperature, lower pH, sweet pleasant aroma, light brown colour. This shows that sweet corn stover can be ensiled successfully with wheat offal or maize offal as energy sources to improve fermentation, storability and acceptability. Hence, farmers can use this approach during the period of forage surplus of the year to mitigate feed wastage and shortage in the dry season to enhance animal productivity.

REFERENCES

Anas, S., Natsir, A., and Syahrir, S. (2024). Organoleptic Test Characteristics of Corn Stover Silage Added with Several Legumes. *Hasanuddin Journal of Animal Sciience*, 6(2):104-113 DOI:10.20956/hajas.v6i2.31778

Barker, D., Frost, M., and Lee, S. (2020). Nutritional benefits of molasses: Focus on minerals and vitamins. Journal of Food Science, 85(3), 467-474.

Dong, Z. J. Li, Wang, S., Dong, D. and Shao, T. (2022). "Time of Day for Harvest Affects the Fermentation Parameters, Bacterial Community, and Metabolic Characteristics of Sorghum-Sudangrass Hybrid Silage," *mSphere*, 7(4):1-18. 0703 600 9304rtega, O., Zaragoza-Esparza, O., Osorio Avalos, J., Robles Jiménez, L. E., and GonzálezRonquillo, M. (2022). Corn silage, a systematic review of the quality and yield in different regions around the world. *Ciencia y*

Tecnología Agropecuaria, 23(3), e2547. https://doi.org/10.21930/rcta.vol23_num3_art:254

Muck, R. E. (2018). Silage production and management. In Silage Science and Technology, 327-372.

Kim, S.C. and Adesogan, A.T. (2006). Influence of ensiling temperature, simulated rainfall, and delayed sealing on fermentation characteristics and Aerobic Stability of Corn Silage. *Journal of Dairy Science*, 89(8):3122–32

Li, F., Ding, Z., Ke, W., Xu, D., Zhang, P., Bai, J., and Guo, X. (2019). Ferulic acid esterase-producing lactic acid bacteria and cellulase pretreatments of corn stalk silage at two different temperatures: ensiling characteristics, carbohydrates composition and enzymatic saccharification. *Bioresource and Technology*, 282:211–21.

Liu, J., Hao, J., Zhao, M., Yan, X., Jia, Y., Wang, Z. and Ge, G. (2024). Effects of different temperature and density on quality and microbial population of wilted alfalfa silage, *BMC Microbiology*, 24:380 https://doi.org/10.1186/s12866-024-03510-2.

Ojo V.O.A, Adelusi O.O, Jimoh S.O, Yusuf K.O, Dele P.A and Adeyemi B.T (2018). Effect of Proportion and Ensiling duration on nutrient digestibility and fermentation characteristics of *pennicetum purpureum* and *Enterolobium cycloarpum* seeds silage using invitro gas production technique. Bulletin of Animal Health and Production in Africa 66:163-175.

SAS (2005). Statistical Analysis System. Guide for personal computers. Version 9.SAS Institute, Inc. Carry, New York City, USA.

Zhou, Y., Drouin, P., and Lafrenière, C. (2016). Effect of temperature (5–25°C) on epiphytic lactic acid bacteria populations and fermentation of whole-plant corn silage. *Journal of Applied Microbiology*, 121(3):657–71. https://doi.org/10.1111/jam.13198