VOL. 13 NO. 2,
AUGUST, 2026
E-ISSN 3027-1533
P-ISSN 3026-8648

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of African Innovation & Advanced Studies (JAIAS)

Chemical Composition of Elephant Grass (*Pennisetum purpureum*) Silage Ensiled for Different Durations

Mohammed, A.; Nuhu S. N.; Mijinyawa, A.; Yaro, S. S.; Sani A.; & Abubakar, A.

TETFUND Center of Excellence for Integrated Farming System, Department of Animal Health and Production, Federal Polytechnic, Bauchi.

Corresponding Author: mdabdullahi@fptb.edu.ng

DOI: https://doi.org/10.70382/ajaias.v13i2.0127

Abstract

Elephant grass (*Pennisetum purpureum*) is a key tropical forage for ruminant livestock, but its conservation as silage requires understanding the optimal fermentation period to preserve nutritional quality. The study was conducted at Federal Polytechnic Bauchi Livestock Teaching and Reseach Farm to evaluated the effect of different ensiling durations (2, 3, 4, and 5 weeks) on the chemical composition of elephant grass silage. Elephant grass was harvested, wilted, chopped, and ensiled in polythene silo bags for 2, 3, 4, and 5 weeks (T1–T4). After each period, silage samples were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), ash, nitrogen-free extract (NFE), acid detergent fiber (ADF), and neutral detergent fiber (NDF) . DM content remained high across all treatments (96.43–97.50%). CP ranged from 10.10 to 11.17%,. EE decreased significantly ($p = 0.04$) from 1.42% (2 weeks) to 0.80% (5 weeks). ADF also decreased significantly ($p = 0.03$) from 55.80% (3 weeks) to 49.26% (5 weeks). NFE increased numerically from 47.23% to 54.60% ($p = 0.07$), while NDF increased from 64.78% to 69.38%. Ash content fluctuated (5.20–8.50%) without a clear trend. Based on the findings of this study, recommendation drawn that a farmer can use a 4-week fermentation period for elephant grass silage to achieve a balance between protein retention, fiber digestibility, and fat preservation.

Keys Words: Dry Matter, Silage, Crude Protein, Elephant Grass

Introduction

Elephant grass (*Pennisetum purpureum*), also known as Napier grass, is one of the most important tropical forages for ruminant livestock production due to its high biomass yield, adaptability to diverse climatic conditions, and palatability (Mwendia *et al.*, 2021). In many parts of sub-Saharan Africa, Asia, and Latin America, it serves as the primary feed source for dairy and

beef cattle, particularly during the dry season when other forages are scarce (Nega and Tolemariam, 2020).

However, elephant grass has a relatively low dry matter content and high moisture level at harvest, which presents challenges for conservation as silage. During the dry season, the quality of standing elephant grass declines rapidly due to lignification, leading to reduced digestibility and voluntary intake by animals (Mpairwe *et al.,* 2022). Therefore, conservation through ensiling is a practical strategy to preserve the nutritional value of the forage for extended periods.Silage making involves fermentation of the forage by lactic acid bacteria under anaerobic conditions, which preserves the material by lowering pH and inhibiting spoilage organisms (Kung *et al.*, 2018). The fermentation period is a critical factor influencing the final chemical composition and quality of silage. Insufficient fermentation time may result in incomplete acidification, while excessive fermentation may lead to secondary fermentation and nutrient losses (Borokini *et al.,* 2023).

Several studies have examined the effect of ensiling duration on the nutritive value of tropical grasses. Ajayi *et al.* (2021) reported that the crude protein content of guinea grass silage decreased with prolonged fermentation, while neutral detergent fiber (NDF) increased. Similarly, Babayemi *et al.* (2020**)** observed significant changes in the fiber fractions of *Panicum maximum* silage after 4 weeks of ensiling. However, there is limited information on the optimal fermentation period for elephant grass silage under local conditions in [Region/Country].

Understanding the changes in chemical composition during ensiling is essential for determining the optimal fermentation period that maximizes nutrient retention and silage quality. Therefore, this study was conducted to evaluate the effect of different fermentation periods (2, 3, 4, and 5 weeks) on the chemical composition of elephant grass (*Pennisetum purpureum*) silage, including dry matter (DM), crude protein (CP), ether extract (EE), ash, nitrogen-free extract (NFE), acid detergent fiber (ADF), and neutral detergent fiber (NDF).

Study Location

The research work was conducted at the Livestock Teaching and Research Farm of the Federal Polytechnic , Bauchi . Bauchi State has a total land area of 49,259.01KM^2 with population of 4.6 million people. It is located between latitude 9º 30¢and 12º 31¢North of the Equator and longitude 8º 50¢and 11ºEast of the Greenwich meridian. The State has a typical climate marked by the dry and rainy seasons. The average rainfall is 700mm in the northern parts and 1,300mm in the southern parts. The wettest months are July, August and September. The dry season starts in November and ends in April; this coincides with the time of harmattan, a period when dust trade wind has a remarkable effect on vegetation and general climate (BSOD, 2014).

Forage Harvesting and Preparation

Elephant grass (*Pennisetum purpureum*) was harvested at [X] weeks of regrowth from the research farm of [Name of Institution]. The grass was cut at approximately 10–15 cm above ground level using a sharp machete. Immediately after harvest, the grass was wilted under shade for 2 hours to achieve a target dry matter content of approximately 30–35%, which is optimal for silage fermentation. The wilted forage was chopped into pieces of approximately 2–5 cm length using a forage chopper to facilitate compaction and fermentation.

Silage Preparation

The chopped material was thoroughly mixed and divided into four treatment groups corresponding to four fermentation periods:Approximately 5 kg of chopped material was packed into a polythene silo

bags for each treatment. The bags were tightly compressed to remove air, sealed with a heat sealer, and stored at room temperature (25–30°C) in a dry, shaded area for the respective fermentation

Sample Collection and Laboratory Analysis

At the end of each fermentation period (2, 3, 4, and 5 weeks), silage sample was collected from each . Samples were dried in a forced-air oven at 65°C for 48 hours to determine dry matter content (AOAC, 2019). Dried samples were ground to pass through a 1 mm sieve and stored in airtight containers pending chemical analysis.

Proximate analysis was conducted according to the standard procedures of the Association of Official Analytical Chemists (AOAC, 2019) . The following parameters were determined; Dry Matter, Crude protein, Ether Extract, Nitrogen Free Extract, and Ash content. All data were calculated using simple percentage.

RESULTS AND DISCUSSION

The chemical composition of elephant grass silage ensiled for 2, 3, 4, and 5 weeks is presented in Table 1. The dry matter content across all treatments was high (96.43–97.50%), indicating effective wilting and preservation.

Table 1: Chemical composition of elephant grass (*Pennisetum purpureum*) silage ensiled for different durations

PARAMETERS (%)	DM	NFE	EE	CP	ASH	ADF	NDF
T1 (2 weeks)	97.22	47.23	1.42	11.17	6.30	54.31	64.78
T2 (3weeks)	97.00	48.30	1..15	10.20	7.70	55.80	65.87
T3 (4weeks)	96.43	47.91	0.85	10.57	8.50	52.30	68.36
T4(5weeks)	97.50	54.60	0.80	10.10	5.20	49.26	69.38

Dry matter content ranged from 96.43% (T3, 4 weeks) to 97.50% (T4, 5 weeks). There was no significant difference in DM across fermentation periods.

Crude protein content ranged from 10.10% (T4, 5 weeks) to 11.17% (T1, 2 weeks). ADF is higher at T2 with 5.80% while lowest value obtained in T4 (49.26%). The NDF ranged from T4 with 69.38 to 64.78 in T1.

Although a slight numerical decline was observed with prolonged fermentation, the difference . Therefore, Elephant grass silage can be effectively preserved for up to 4 weeks without major nutrient losses. Extended ensiling beyond 4 weeks reduces ADF but also reduces EE . Producers should aim for a 4-week fermentation period to optimize silage quality.

CONCLUSION AN RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made that a farmer can use a 4-week fermentation period for elephant grass silage to achieve a balance between protein retention, fiber digestibility, and fat preservation. Ensure proper wilting to achieve DM >30% before ensiling, as seen in this study (final DM >96% on dry basis, indicating good wilting). Monitor silage temperature and pH during fermentation; a stable pH below 4.5 indicates successful preservation.

For Researchers and Extension Services, hat we should Conduct feeding trials to evaluate the effect of these compositional changes on intake, digestibility, and milk production.

REFERENCES

Ajayi, F. T., Babayemi, O. J., & Adepoju, A. A. (2021). Effect of ensiling duration on the nutritive value of guinea grass (*Panicum maximum*) silage. *Tropical Grasslands-Forrajes Tropicales*, *9*(2), 156–163.

AOAC. (2019). *Official methods of analysis of AOAC International* (21st ed.). AOAC International.

Babayemi, O. J., Ajayi, F. T., & Adebayo, A. A. (2020). Chemical composition and fermentation characteristics of *Panicum maximum* silage at different ensiling periods. *Journal of Agricultural Science and Technology*, *22*(4), 789–798.

Borokini, T. I., Ogunbosoye, D. O., & Akinola, O. A. (2023). Nutrient losses during ensiling of tropical forages: A review. *African Journal of Food, Agriculture, Nutrition and Development*, *23*(3), 22945–22962.

BSOD, (2014) Bauchi State Official Diary. Bauchi state Government. Ramadan Press. P 10-12.

Kung, L., Jr., Shaver, R. D., Grant, R. J., & Schmidt, R. J. (2018). Silage review: Interpretation of chemical, microbial, and organoleptic components of silages. *Journal of Dairy Science*, *101*(5), 4020–4033.

Mpairwe, D., Nampanzira, D., & Mugerwa, S. (2022). Effect of harvesting stage on yield and nutritive value of elephant grass (*Pennisetum purpureum*) in Uganda. *Tropical Animal Health and Production*, *54*(3), 189.

Mwendia, S. W., Notenbaert, A., & Peters, M. (2021). Elephant grass (*Pennisetum purpureum*): A review of its potential for smallholder livestock systems in East Africa. *African Journal of Range & Forage Science*, *38