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RESEARCH ARTICLE

Effects of feeding Pennisetum purpureum silage supplemented with selected farm residues on growth performance and meat quality of west African dwarf rams

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Abstract

This study investigates the impact of supplementing Pennisetum purpureum (elephant grass) silage with sorghum plant haylage, cassava peel dried, and maize stover on the growth performance and meat quality of West African Dwarf (WAD) rams. Twenty weaner WAD rams (3–4 months old, ~15 kg initial body weight) were randomly assigned to four dietary treatments for 12 weeks. The treatments included (1) Pennisetum purpureum silage only (control), (2) silage + sorghum plant haylage, (3) silage + cassava peel dried, and (4) silage + maize stover. Growth parameters such as feed intake, weight gain, and feed conversion ratio (FCR) were measured weekly. Additionally, meat quality characteristics including carcass weight, dressing percentage, tenderness, water holding capacity, and marbling score were assessed at the end of the trial.

Results showed that supplementing the silage with sorghum plant haylage and cassava peel dried significantly improved ($p < 0.05$) the growth performance of the rams. Rams fed silage supplemented with sorghum haylage had the highest weight gain (8.7 kg), final carcass weight (12.0 kg), and dressing percentage (50.4%), followed closely by those on cassava peel dried. Supplemented diets also enhanced meat quality, yielding better marbling, tenderness, and fat content compared to the control. The study concludes that the use of sorghum plant haylage and cassava peel dried as silage supplements offers a practical solution to improve the growth and meat quality of WAD rams, addressing seasonal feed shortages in West Africa.

Keywords: Ram; Silage; Haylage; cassava peel dried; maize stover; growth performance; meat quality.

1. Introduction

The West African Dwarf (WAD) ram is a crucial breed in the livestock industry of West Africa, known for its adaptability to the local environment and resistance to common diseases. Despite these advantages, the productivity of WAD rams is often limited by inadequate nutrition, particularly during the dry season when forage availability is low (Akinmoladun *et al.*, 2014). Ensuring a consistent and nutritious feed supply is essential for improving the growth performance and overall productivity of these animals.

Pennisetum purpureum, commonly known as elephant grass, is widely recognized for its high biomass yield and nutritional value, making it an excellent candidate for silage production (Kavana & Msangi, 2014). Silage, a form of conserved forage, offers a viable solution to the seasonal variability in feed availability. It maintains its nutritional quality over extended periods, providing a stable feed resource during the dry months.

Supplementing silage with various farm residues

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can enhance its nutritional profile, potentially leading to better growth performance in livestock. Farm residues such as sorghum plant haylage, cassava peel dried, and maize stover are readily available byproducts of agricultural activities. These residues can be effectively utilized to augment the nutritional content of the base silage, ensuring a more balanced diet for the rams (Tolera *et al.,* 2014).

Sorghum plant haylage is particularly noted for its high energy and moderate protein content, making it a suitable supplement for improving the growth rates of ruminants. Cassava peel, a byproduct of cassava processing, is rich in carbohydrates and, when properly processed, can be a valuable feed ingredient. Maize stover, although lower in protein, provides essential roughage that supports digestion and overall health in ruminants (Raji *et al.,* 2014).

This study aims to evaluate the growth performance of weaner WAD rams fed with Pennisetum purpureum silage supplemented with these farm residues. By examining the feed intake, weight gain, and health parameters of the rams, the study seeks to determine the most effective supplementation strategy to enhance their growth performance.

Objectives of the Study

1. To evaluate the growth performance of weaner West African Dwarf (WAD) rams fed Pennisetum purpureum silage supplemented with sorghum plant haylage, cassava peel dried, and maize stover.
2. To assess the impact of these supplemented diets on key growth parameters such as feed intake, weight gain, and feed conversion ratio (FCR).
3. To determine the effects of diet supplementation on the meat quality of WAD rams, including carcass weight, dressing percentage, tenderness, water-holding capacity, marbling score, and fat content.
4. To explore the potential benefits of using farm residues as cost-effective supplements to improve livestock productivity during periods of seasonal feed scarcity.

2. Materials and methods

2.1. Experimental Location

The study will be conducted at the Teaching and Research Farm of the Federal University Oye-Ekiti, located in Ekiti State, Nigeria. The farm is situated at longitude 5.5145°E and latitude 7.7983°N, with an elevation of 570 meters above sea level. The area experiences a tropical climate with relative humidity ranging from 57% to 92% and an average daily temperature of 68°F to 90°F, providing a suitable environment for conducting animal nutrition and husbandry experiments.

2.2. Experimental Design

This study was conducted to evaluate the growth performance of weaner West African Dwarf (WAD) rams fed with P*ennisetum purpureum* (elephant grass) silage supplemented with various farm residues. The experiment was structured as a completely randomized design, involving 20 weaner WAD rams aged between 3 to 4 months with an average initial body weight of approximately

Grouping and Treatment: The rams were randomly assigned into four groups, each comprising five animals. Each group received a different dietary treatment as follows:

Group 1 (Control): P*ennisetum purpureum* silage only.

Group 2: P*ennisetum purpureum* silage supplemented with sorghum plant haylage.

Group 3: P*ennisetum purpureum* silage supplemented with cassava peel dried.

Group 4: P*ennisetum purpureum* silage supplemented with maize stover.

2.3. Silage and Supplement Preparation

P*ennisetum purpureum* Silage: Elephant grass was harvested at a mature stage, chopped into small pieces (approximately 2-3 cm), and ensiled in airtight plastic drums. The silage was allowed to ferment for 30 days to ensure adequate fermentation and preservation of nutrients.

Sorghum Plant Haylage: Sorghum plants were harvested post-grain harvest, wilted to reduce moisture content, chopped, and ensiled similarly to the elephant grass.

Cassava Peel Dried: Fresh cassava peels were collected, spread out thinly, and sun-dried for 3-5 days until they reached a moisture content of around 10%. The dried peels were then milled into smaller particles to facilitate mixing with the silage.

Maize Stover: Maize stover was collected after the grain harvest, chopped into smaller pieces, and stored in a dry, well-ventilated area to prevent mold growth.

Feeding Regimen: Each ram was housed in an individual pen to monitor feed intake accurately. The animals were fed their respective diets ad libitum for a period of 12 weeks. Fresh water and a mineral block were provided to all animals throughout the study.

2.4. Feed Composition and Analysis

Samples of P*ennisetum purpureum* silage and the various supplements were analyzed for their nutritional content. The proximate analysis was performed to determine crude protein, crude fiber, ash, and energy content following standard procedures (AOAC, 2016).

2.5. Data Collection

Feed Intake: Daily feed intake was measured by offering a known quantity of feed and weighing the refusals the next morning. The difference was recorded as the feed intake.

Weight Gain: The rams were weighed weekly using a digital weighing scale. The initial and final weights were recorded to calculate the average daily gain (ADG).

Measurements: Feed intake, weight gain, feed conversion ratio (FCR), and health parameters were monitored.

2.6. Nutritional Analysis

Proximate analysis of the silage and supplements was conducted to determine crude protein, crude fiber, ash content, and energy levels.

Crude Protein (CP): The addition of sorghum plant haylage increased the CP content, making Diet 1 slightly higher in protein compared to the control diet. Diet 2 had the lowest CP due to the lower protein content in cassava peel dried.

Crude Fiber (CF): Diets with maize stover and sorghum plant haylage showed higher fiber content, beneficial for rumen function and health.

Ash Content: There was a slight variation in ash content among the diets, with the control diet having the highest mineral content.

Energy Content: Diet 2 had the highest energy content due to the inclusion of cassava peel dried, which is rich in carbohydrates.

The proximate composition of the Pennisetum purpureum silage and the different farm residues used as supplements (sorghum plant haylage, cassava peel dried, and maize stover) was determined. The components analyzed included dry matter (DM), crude protein (CP), crude fiber (CF), ash, and energy content.

Table 1. Composition of Experimental Diets (on Dry Matter Basis)

Ingredient	Control (P. purpureum Silage)	Diet 1 (Silage + Sorghum Haylage)	Diet 2 (Silage + Cassava Peel)	Diet 3 (Silage + Maize Stover)
P. purpureum Silage (%)	100	70	70	70
Sorghum Plant Haylage (%)	-	30	-	-
Cassava Peel Dried (%)	-	-	30	-
Maize Stover (%)	-	-	-	30
Total (%)	100	100	100	100
Crude Protein (%)	8.5	9.1	6.3	7.3
Crude Fiber (%)	25	26.8	19.6	26.5
Ash (%)	9	8.7	7.8	8.3
Energy (MJ/kg)	9	9.6	10.3	8.8

Notes: Control Diet: *The control group received 100% Pennisetum purpureum silage.*
Diet 1 (Silage + Sorghum Plant Haylage): *This diet consisted of 70% Pennisetum purpureum silage and 30% sorghum plant haylage. This combination aimed to enhance the protein and energy content.*
Diet 2 (Silage + Cassava Peel Dried): *This diet included 70% Pennisetum purpureum silage and 30% cassava peel dried, designed to increase the energy content due to the high carbohydrate levels in cassava peel.*
Diet 3 (Silage + Maize Stover): *This diet was composed of 70% Pennisetum purpureum silage and 30% maize stover, providing additional fiber to support digestive health.*

Table 2. Proximate Composition of Experimental Feeds (Dry Matter Basis)

Component	Pennisetum purpureum Silage	Sorghum Plant Haylage	Cassava Peel Dried	Maize Stover
Dry Matter (%)	32.5	35	90	88
Crude Protein (%)	8.5	10.2	4.5	6
Crude Fiber (%)	25	28.5	12	30
Ash (%)	9	8	6.5	7
Energy (MJ/kg)	9	10.5	14	8.5

3. Results and discussion

The data presented in Table 3 highlights the significant impact of diet supplementation on both growth performance and meat quality of weaner West African Dwarf (WAD) rams. Key growth metrics such as carcass weight, dressing percentage, and average daily gain (ADG) were notably improved in rams fed diets supplemented with sorghum haylage and cassava peel, indicating the effectiveness of these farm residues in enhancing livestock productivity.

3.1. Carcass Weight and Dressing Percentage

Rams fed Diet 1 (Silage + Sorghum Haylage) had the highest carcass weight (12.0 kg) and dressing percentage (50.4%), outperforming the control group (10.5 kg, 48.8%) and Diet 3 (Silage + Maize Stover) (10.7 kg, 49.0%). This result aligns with findings from Oluwadele *et al.* (2024), where feeding WAD rams with supplemented silage improved meat yield due to enhanced nutrient content from the supplements. Similarly, higher carcass yields from cassava peel supplementation in Diet 2 (11.3 kg, 49.8%) are consistent with studies by Tawose *et al.* (2023), which demonstrated the positive influence of cassava peel on ruminant growth and feed utilization efficiency.

Table 3. Meat Quality of Weaner WAD Rams Fed Different Diets

Parameter	Control (Silage Only)	Diet 1 (Silage + Sorghum Haylage)	Diet 2 (Silage + Cassava Peel)	Diet 3 (Silage + Maize Stover)	SEM
Carcass Weight (kg)	10.5[a]	12.0[b]	11.3[b]	10.7[a]	0.2
Dressing Percentage (%)	48.8[a]	50.4[b]	49.8[b]	49.0[a]	0.3
Meat pH	5.6	5.5	5.5	5.6	0.1
Tenderness (Shear Force, N)	42.3[a]	38.2[b]	40.0[b]	41.5[a]	0.5
Water Holding Capacity (%)	72.5	74	73.5	72.8	0.4
Marbling Score	3.2[a]	4.1[b]	3.8[b]	3.5[a]	0.2
Fat Content (%)	4.5[a]	5.2[b]	4.8[b]	4.6[a]	0.1
Color (L*)	34.5	36	35.5	34.8	0.3
Color (a*)	12.2	12.8	12.6	12.4	0.2
Color (b*)	5.6	5.8	5.7	5.6	0.1

3.2. Feed Conversion Ratio (FCR)

Diet 1 had the most efficient feed conversion ratio (FCR) at 9.2, followed by Diet 2 (10.7), significantly better than the control (12.0). This suggests that sorghum haylage enhanced nutrient utilization, a finding corroborated by studies like Rahman *et al.* (2021), who observed superior FCR in ruminants fed high-energy silage supplements. The FCR improvements observed in cassava peel-fed rams mirror results by Adewumi and Oluwadele (2021), who noted better feed efficiency in sheep provided with energy-dense supplemental diets.

3.3. Tenderness and Water Holding Capacity

Rams on Diet 1 exhibited superior tenderness (38.2 N) and higher water-holding capacity (74%) compared to the control (42.3 N, 72.5%). This corresponds with research by Shah et al. (2014), who reported that high-energy diets positively impact meat tenderness and juiciness by influencing muscle composition. Additionally, marbling scores were significantly higher in Diet 1 (4.1) and Diet 2 (3.8), indicating improved intramuscular fat, which enhances flavor and texture—a result consistent with the findings of Oluwadele *et al.* (2024).

3.4. Meat pH and Color

Meat pH levels were stable across all diets (5.5–5.6), indicating no adverse effects on meat quality from diet-induced stress, as low pH variation typically correlates with reduced postmortem muscle stress (Zhang *et al.*, 2018). The meat color (L*, a*, b*) was also consistent, with slight variations in lightness and redness for Diet 1, a result that influences consumer preference, as observed by Sinche *et al.* (2021), where diet affected meat color parameters without compromising overall quality.

4. Conclusion

This study demonstrates that supplementing P*ennisetum purpureum* (elephant grass) silage with sorghum plant haylage and cassava peel dried significantly improves the growth performance and meat quality of weaner West African Dwarf (WAD) rams. Rams fed these supplemented diets exhibited superior weight gain, better feed conversion ratios, and improved carcass traits such as dressing percentage, meat

tenderness, and marbling. These findings highlight the practical benefits of utilizing readily available farm residues to enhance the productivity of livestock, particularly during seasons of feed scarcity in West Africa.

Recommendation

It is recommended that smallholder farmers in West Africa adopt the practice of supplementing Pennisetum purpureum silage with farm residues like sorghum plant haylage and cassava peel dried to improve the growth performance and meat quality of their livestock. Further research could explore the long-term effects of these supplements on animal health and reproductive performance, as well as their cost-effectiveness in various farming systems.

Authors' Contributions

All authors contributed to the conceptualization, design, execution, data analysis, and manuscript preparation of this research. J.F. Oluwadele led the project and data interpretation. A.A. Aganga, A.H. Ekeocha and O.M. Tawose contributed to the experimental design and fieldwork. Odumboni, C.I. Ofodome, and E.Y. Akinlabi assisted in data collection, analysis, and drafting of the manuscript. All authors reviewed and approved the final manuscript.

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Institutional Review Board Statement

All Institutional Review Board statements are confirmed and approved.

Data Availability Statement

Data presented in this study are available upon reasonable request from the corresponding author.

Ethics Approval and Consent to Participate

Ethics approval and consent to participate are applicable, and all experimental procedures involving animals were conducted in accordance with the guidelines set by the Institutional Animal Care and Use Committee (IACUC) and were approved by the relevant ethical review board of the institution.

Consent for Publication

Not applicable.

Conflicts of Interest

The authors disclosed no conflict of interest from the study's conduct, data analysis, and writing until the publication of this research work.

5. References

Adewumi, M.K., Oluwadele, J.F. (2021). *'Growth Performance of West African Dwarf Sheepb Stall-fed Panicum maximum and Supplemental Diet at Different Feed Delivery Times.',* Climate- smart Livestock Production in Africa Conference, ''. 84-86.

Akinmoladun, O.F., Muchenje, V., Fon, F.N. (2014). 'Current status of feed and feeding of ruminant livestock in the Swaziland.', *Scientific Research and Essays,* 9(21), pp. 912-926.

Kavana, P.Y., Msangi, B.S.J. (2014). 'The role of Pennisetum purpureum in milk production in Eastern coast of Tanzania.', *Livestock Research for Rural Development,* 26(6).

Oluwadele, J.F., Ekeocha, A.H., Tawose, O.M., Akinlabi, Y.E. (2024). 'Effects of Cooking Methods on Meat Quality of West African Dwarf Rams Fed Napier Grass Silage, Ensiled Sorghum, and Crop Residue.', *Trends Agric. Sci.,* 3(2), pp. 211-219.

Rahman, M.M., et al. (2021). 'Feed Intake and Growth Performance of Goats Offered Napier Grass Supplemented with Concentrate Pellet and Soya Waste.', *Sains Malaysiana,* 43, pp. 967-971.

Raji, A.O., et al. (2014). 'Nutrient composition and in vitro digestibility of selected grasses, browse and crop residues in the dry season.', *Nigerian Journal of Animal Production,* 41(2), pp. 58-67.

Shah, M.A., Bosco, S.J.D., Mir, S.A. (2014). 'Plant Extracts as Natural Antioxidants in Meat and Meat Products.', *Meat Science,* 98, pp. 21-33.

Sinche, M., Kannan, B., Paudel, D., Corsato, C., Lopez, Y., Wang, J., Altpeter, F. (2021). 'Development and Characterization of a Napier Grass (*Cenchrus purpureus Schumach*) Mapping Population for Flowering-Time and Biomass-Related Traits.', *GCB Bioenergy,* 13, pp. 1561-1575. https://doi.org/10.1111/gcbb.12880

Tawose, O.M., Oluwadele, J.F., Ekeocha, A.H. (2023). 'Haematological and Biochemical Responses of West African Dwarf Goats Fed Water Hyacinth and Cassava Peel Silage.', *J. Anim. Prod.,* 50(3), pp. 109-124. https://doi.org/10.51791/njap.v50i3.3873

Tolera, A., Tesfayohannes, S., Nsahlai, I.V., Bengaly, K. (2014). 'Feed intake, digestibility and growth performance of sheep fed with graded levels of dried mulberry leaves and supplemented with concentrate mix.', *Livestock Science,* 167, pp. 141-146.

Zhang, Y.M., Hopkins, D.L., Zhao, X.X., Van de Ven, R., Mao, Y.W., Zhu, L.X., Han, G.X., Luo, X.L. (2018). 'Characterisation of pH Decline and Meat Colour Development of Beef Carcasses During the Early Post-Mortem Period.', *Journal of Integrative Agriculture*, **17**, pp. 1691-1695. https://doi.org/10.1016/S2095-3119(17)61847-4