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ENHANCED NUTRITIONAL PROFILE FROM ENSILED PROPORTIONS OF THREE SPECIES SILAGE

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1. Introduction

Provision of quality feed in high quantity for ruminants, particularly in sub-Saharan Africa, remains a persistent challenge for the livestock industry. This constraint has resulted in deteriorating livestock performance, with reduced milk yield, weight loss, and suboptimal reproduction, especially during the dry season (Osuji, 2008).

Conservation of forages offers a potential solution to mitigate seasonal feed scarcity by protecting livestock against forage shortages. However, the availability of forages throughout the year is restricted in tropical regions, posing a major challenge.

Crop residues are commonly utilized as animal feed and help address issues of crop residue disposal and environmental sustainability. Despite their availability and potential as an alternative feed resource, crop residues are generally high in fibre but low in crude protein, limiting their nutritional value. Enriching crop residues with nutrient-rich forage legumes improves the nutrient content of ensiled tropical plant residues, enhances ensiling properties, and promotes better nutrient uptake in ruminants.

This study examined the mineral and anti-nutritional content of maize stover and *Hibiscus sabdariffa* residues ensiled with the forage legume *Calopogonium mucunoides*.


Hibiscus sabdariffa


Calopogonium mucunoides

2. Method

Maize stovers (ZM) were harvested immediately after cob removal and crushed, while Hibiscus sabdariffa (HS) residue was obtained from zobo drink manufacturers after processing. Calopogonium mucunoides (CM) was harvested at 8 weeks of growth, 15 cm above ground level, from a pasture farm.

All materials were wilted for four hours, then chopped into 2 cm pieces. Ingredients were mixed in the following proportions: ZM:HS:CM – 70:0:30, 70:15:15, 70:30:0, and 100:0:0 (control). Each mixture (~500 ± 50 g) was ensiled at 0.52 g/mL density in 960 mL glass silos, sealed with duct tape, and stored at 26°C for 45 days.

The experiment followed a completely randomized design with four treatments, each replicated three times. After 45 days, silos were opened for sampling and analysis of mineral and anti-nutritional contents. Calcium and phosphorus were determined via AOAC (2000) spectroscopy methods.

Tannin content was assessed following James (1995), and saponin content according to Obadoni and Ochuko (2001). Data were analyzed using one-way ANOVA and treatment means compared by Tukey's HSD test.

3. Results

All silage mixtures had calcium and phosphorus levels within the optimal range required for ruminant nutrition (Farhad, 2012; Suttle, 2022) (Table 1).

The control silage (maize stover only) had the highest ($p<0.05$) calcium and phosphorus, likely due to the absence of dilution effects from added residues.

Silage mixtures with *Calopogonium mucunoides* alone significantly ($p<0.05$) increased nitrogen content, however, this also resulted in significantly ($p<0.05$) higher anti-nutritional factors (tannins and saponins) in the silage.

Silage containing equal proportions of *Calopogonium mucunoides* and *Hibiscus sabdariffa* (MS 70: HS 15: CM 15) had a more balanced nutritional profile, combining adequate minerals, moderate nitrogen, and lower anti-nutritional factors.

Table 1. Mineral and anti-nutritional contents of crop residues (Maize stover and *Hibiscus sabdariffa*) silage enriched with *Calopogonium mucunoides*

	Calcium	Phosphorus	Ca:P	Nitrogen	Tannin	Saponin
Proportion (%)	← g/kg →			← g/kg →		
MS 100: HS 0: CM 0	4.04^{a}	3.11^{a}	1.30^{b}	1.09^{c}	-	-
MS 70: HS 0: CM 30	3.73^{b}	2.94^{b}	1.27^{b}	1.88^{a}	5.42^{a}	2.61^{a}
MS 70: HS 30: CM 0	3.06^{d}	2.01^{d}	1.52^{a}	1.38^{b}	4.02^{b}	0.78^{c}
MS 70: HS 15: CM 15	3.62^{c}	2.87^{c}	1.26^{b}	1.44^{b}	4.23^{b}	1.32^{b}
SEM	0.11	0.13	0.03	0.04	0.62	0.29
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

^{abcd}: Means on columns with different superscripts differ significantly ($P < 0.05$); SEM: Standard error of mean; Maize stover (MS); *Hibiscus sabdariffa* (HS); *Calopogonium mucunoides* (CM)


Maize Stover

4. Conclusion

Ensiling the three species had a more balanced nutrient profile than the ensiled binary and sole silage proportions. Since there is in-balance in the nutrient profile with the binary and sole silage proportions.


Silage

5. References

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