

MACRO AND MICRO MINERALS OF ROSELLE (*Hibiscus sabdariffa* L.) HUSKS ENSILED WITH MOLASSES AS AN ADDITIVE

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Abstract

This study was conducted to evaluate the macro and micro minerals of *Hibiscus sabdariffa* husks ensiled with graded levels of molasses as additive. The research was conducted at Department of Animal Health and Production Technology (AHPT), BUPoly, Hadejia, Nigeria. Roselle (*Hibiscus sabdariffa* L.) husks were collected from the Polytechnic farm after harvest in the year 2024. The husks were chopped to 2 – 3 cm and were mixed with Molasses at 0g, 5g, 10g and 15g as an additive to constitute four treatments as Trx1, Trx2, Trx3 and Trx4 in Completely Randomized Design, and each treatment was replicated three times and then ensiled for 3weeks. The findings showed significantly differences ($P<0.05$) across all the assessed parameters. pH scale range from 4.00 in Trx1 to 4.85 in Trx4. Trx2 leads in Ca, Mg and Na while Trx1 leads in Fe, Mn and Zn. Those with least values were Trx4 (Ca, Mg, Mn and Zn), Trx1 (Na) and Trx3 (Fe). Therefore, addition of molasses at 5g increase the macro minerals content of the silages, at the same time decrease the micro minerals, whereas as the inclusion levels of molasses increasing (10g and 15g) the macro minerals decreasing and vice-versa. Trx2 (5g Molasses) resulted in silage with pleasant aroma, pale yellow colour, moderate pH (4.20) and high macro minerals contents. The study concluded that addition of molasses at 5g to Roselle (*Hibiscus sabdariffa* L.) husks silage improved its macro mineral contents and recommended that farmers should add molasses at 5g for better silage.

Keywords: *Ensiling, Hibiscus sabdariffa, Husk, Molasses and Mineral Contents.*

Introduction

Minerals are essential nutrients that play critical roles in the physiological, metabolic, reproductive and immune functions of livestock, in most extensive and semi-intensive systems, ruminant depend largely on forages and crop residues for their nutrient requirement (Leng, 2008). However, ruminant grazing solely on low mineral pastures or fed crop residues without supplementation are at risk.

Crop residues and forages form a large portion of livestock diets in tropical and subtropical regions. However, their minerals composition is often inadequate to meet ruminant requirement (Abdurrahman *et al.*, 2018). Deficiencies, especially of calcium, phosphorus and micro minerals, can severely affect animal productivity and health (Abdurrahman, 2017; NRC, 2001). It is therefore essential to evaluate feed resources and implement appropriate supplementation strategies to ensure optimal mineral nutrition in ruminant.

Silage additives are manufactured or natural items that are added to grain or fodder in sufficient amounts to enhance their nutritional content and guarantee that lactic bacteria will proliferate throughout the fermentation process (Abdurrahman, 2017). The majority of the energy, protein, and other nutrients included in the original plant are retained during the process of ensiling, which is used to preserve fodder resources for use by cattle (Stewart *et al.*, 2011). It

has been demonstrated through multiple silage tests that molasses is a useful silage additive for encouraging lactic acid fermentation, lowering silage pH, preventing clostridia fermentation and proteolysis, and generally lowering losses of organic matter (Yitbarek and Tamir, 2014). This research was planned to determine the effect of graded level of molasses inclusion in *Hibiscus sabdariffa* husks silage and conclude the best treatment in terms of macro and micro mineral contents.

Methodology

Study Location

The trial was carried out in the Department of AHPT's Animal Nutrition Laboratory BUPoly, Hadejia, Nigeria. According to JARDA, (2025), Hadejia is located between latitudes 12⁰ 13¹ and 13⁰ 60¹N and longitudes 9⁰ 22¹ and 11⁰ 00E. The region has a semi-arid climate. Its extended dry season “Rani” and brief wet season “Damina”, which lasts from June to September, are its defining features. According to JARDA, (2025), the region has 600 mm to 762 mm of annual rainfall and average annual temperatures between 27.2⁰C and 30⁰C.

Experimental Design and treatments

Table 1 illustrates how the research trial was set up using a Completely Randomized Design (CRD) with four (4) treatments each in triplicated.

Table 1: Treatment of *Hibiscus sabdariffa* husks Combination with Graded Level of Molasses Inclusion

Treatment	Crop residue Type	Molasses Level (g)
Trx1	<i>Hibiscus sabdariffa</i> husks	0
Trx2	<i>Hibiscus sabdariffa</i> husks	5
Trx3	<i>Hibiscus sabdariffa</i> husks	10
Trx4	<i>Hibiscus sabdariffa</i> husks	15

Preparation of the ensiled *Hibiscus sabdariffa* husks

Sixty (60kg) *Hibiscus sabdariffa* husks were collected from Polytechnic farm after harvest in the year 2024 and chopped manually with a sharp cutlass to a length of 2 - 3cm. The husks were sprinkled with Six (6 liters) of water and allowed for three hours before adding the Molasses in solution (1.5Liters) based on the treatments per 15kg husks. After the application of the additive (Molasses), the husks were ensiled in laboratory silage bottles (473mL) capacity. To create an anaerobic environment ideal for fermentation, each treatment combination silo was squeezed until it was completely full, and then duplicated into three. The silos were then left at 28 – 30 °C for three (3) weeks after air sealer was applied to the lids cover. Following a 21-day fermentation phase, the silos' contents were inspected and color-coded. Tongs were used to retrieve sub-samples from the experimental silos, and the contents were assessed using colour and aromatic scored table, as indicated in Table 2. The silos were opened, and the contents from the top of the silos were removed out to protect against contamination by the air sealant used.

The pH was then measured with a digital pH meter. Subsamples from the silos were collected and the proximate compositions were analyzed in biochemistry laboratory.

Table 2: Colour and Aromatic scored

Score	Colour	Aroma
1	Yellowish green	Rancid
2	Pale yellow	Pleasant
3	Light brown	Sweet
4	Dark or Deep brown	Extremely sweet

Abdurrahaman *et al.*, (2018).

Macro and micro mineral contents analysis of the prepared silages

The macro (Ca, Mg and Na) and micro (Fe, Mn and Zn) mineral contents analysis was performed using the methodology developed by AOAC (1999).

Data Analysis

Fisher's Least Significant (FLS) was used to distinguish mean differences at a probability level of 0.05 in the analysis of the data, which was conducted using SAS (2013)'s completely randomized design (CRD).

Results and Discussions

Results

Ph , colour and aromatic of *Hibiscus sabdariffa* husks silage with graded level of molasses inclusion

Table 3 presents the graded level of molasses inclusion with the pH, color, and scent of ensiled *Hibiscus sabdariffa* husks. The resulting silage had a pH change that was statistically significant ($P < 0.05$). The pH range, which was within the advised range (Abdurrahaman *et al.*, 2018) of 4.40 to 5.50, is 4.00 to 4.85. The findings showed that there is a correlation between aroma and pH: the hay with the lowest pH (4.00) smells nice, but as pH alkalinity rises, the aroma is highly sweet.

Table 3: pH value, Colour and Aroma of Silage of *Hibiscus sabdariffa* husks with Graded Level of Molasses Inclusion

Treatments	Parameters		
	pH	Colour	Aroma
T1	4.00 ^d	2	2
T2	4.20 ^c	2	3
T3	4.35 ^b	2	3
T4	4.85 ^a	2	4
SE±	0.04		

a, b, c and d Means with the same superscripts along column are not significantly difference ($P < 0.05$) Colour: 1= Yellowish green, 2= Pale yellow, 3=Light brown, 4= Dark brown. Aroma: 1 = Rancid, 2 = Pleasant, 3 = Sweet, 4 = Extremely sweet.

Macro and micro minerals contents of *Hibiscus sabdariffa* husks with different molasses inclusion levels

The macro and micro mineral contents of ensiled *Hibiscus sabdariffa* husks at varying levels of molasses inclusion are displayed in Table 4. The macro (Ca, Mg, and Na) and micro (Fe, Mn, and Zn) mineral contents of the compounded silages differed significantly ($P < 0.05$). T1 was

superior in Fe, Mn, and Zn, whereas T2 was superior in Ca, Mg, and Na. T4 (Ca, Mg, Mn, and Zn), T1 (Na), and T3 (Fe) had the lowest values.

Table 4: Macro and Micro Minerals Contents of ensiled *Hibiscus sabdariffa* husks with different Molasses Inclusion Levels

Treatment	Parameters (ppm)					
	Ca	Mg	Na	Fe	Mn	Zn
T1	102.70 ^b	102.30 ^b	16.54 ^d	8.85 ^a	3.74 ^a	0.73 ^a
T2	106.90 ^a	110.40 ^a	29.60 ^a	6.72 ^c	3.16 ^b	0.61 ^c
T3	102.20 ^c	82.23 ^c	26.15 ^b	6.09 ^d	2.95 ^c	0.64 ^b
T4	81.95 ^d	43.31 ^d	18.88 ^c	7.26 ^b	2.57 ^d	0.51 ^d
SE±	0.03	0.04	0.01	0.01	0.04	0.04

^{a, b, c and d} Means with the same superscripts along column are not significantly difference ($P < 0.05$) Ca = Calcium, Mg = Magnesium, Na = Sodium, Fe = Iron, Mn = Manganese, Zn = Zinc.

Discussions

pH value, colour and aroma of ensiled of *Hibiscus sabdariffa* husks with different molasses inclusion levels

One of the easiest and quickest techniques to assess the qualities of silage is to measure its pH. According to Kung and Shaver (2002), a pleasant aroma and good quality silage has a pH value of 4.3–4.7. The pH values increased linearly when the additive (molasses) was added. The pH levels of each treatment analyzed was within the reference range (Kung and Shaver 2002). This is consistent with a report by Leterme *et al.* (1992), who found that ensiling pressed pulp of sugar-beet with urea and molasses, laying hen droppings increased the pH of the silage. These results linked this increase to the buffering capacity of the pulp, which was caused by ammonia from the hydrolysis of uric acid. Abdurrahman *et al.* (2018) also observed a pH range of 4.04 to 7.04. Akinwande *et al.* (2011) also reported a pH value of 9.26. Baba *et al.* (2010) found that when *Pennisetum pedicellatum* hay was ensiled with different amounts of chicken droppings, the pH values ranged from 5.51 to 7.21. Silage's color and scent can also be used to assess its quality as reported by Wattiaux, (2000). The colors found in this study were fairly close to the original hue of the silage-making components. This observation is consistent with the findings of Oduguwa *et al.* (2007) and Babayemi *et al.* (2010), who used different feed materials but comparable procedures.

Macro and micro minerals contents of ensiled *Hibiscus sabdariffa* husks with different molasses inclusion levels

For the rumen microbes to function properly especially those that break down plant cellulose, the use of protein, energy, and metabolism minerals are very essential (Gumel *et al.*, 2020; Ishiaku *et al.*, 2016). The percentage values of Ca (0.78%) reported by Uzun *et al.* (2009) in Sugargraze forage, was less than the analyzed values (106.90 - 81.95%) this show that dried crops residue has higher mineral contents than fresh forage. The calcium readings in this study exceeded the recommended value (0.31%) for beef cattle, according to Uzun *et al.* (2009). All of the calcium values that were examined were greater than the 0.5–1.1 g daily recommended intake for goats (Hassan *et al.*, 2014; Ishiaku *et al.*, 2016). According to Ishiaku *et al.* (2016), the Columbus grass forage data (Na: 2.11g/100g, Mn: 42.13mg/100g, and Fe: 127.39mg/100g) are consistent with the current findings. Na: 29.60 ppm, Mn: 3.74 ppm, and Fe: 8.85 ppm are the values.

This indicated that feeding these silages might not need the addition of minerals and could be related to the kind of soil and amount of fertilizer used in the field.

Conclusion and Recommendation

Conclusion

The macro and micro mineral contents of the *Hibiscus sabdariffa* husk silage has enhanced with the addition of molasses. The study's findings showed that adding molasses produces silage that is of higher mineral contents, has a very pleasant aroma, and is pale yellow in color with moderate pH.

Recommendation

It is necessary to conduct further research on feeding trial. The study does advise farmers to add 5g of molasses, as this produced pleasant silage with high macro minerals.

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