

# Impact of Treated Maize Stover with Urea-molasses Solution on the Chemical Composition and *In Vitro* Gas Production.

Akinfemi, A.<sup>1\*</sup>, Komolafe, P.M.<sup>2</sup>, Awoh, C.D.<sup>1</sup> and Usman, A.S.<sup>1</sup>

<sup>1</sup>Yaba College of Technology, Department of Agric. Technology, Epe Campus, Lagos

<sup>2</sup>Bamidele Ohumilua University of Education, Science and Technology, Ikere Ekiti, Ekiti State.

\*Corresponding author email: [akinfemiabayomi@gmail.com](mailto:akinfemiabayomi@gmail.com) phone number: +2348033371818

**Target audience:** Livestock producers, animal nutritionists, veterinary experts, and researchers working in the domains of agriculture and animal science

## Abstract

The purpose of this work was to evaluate the effects of treated maize stover with urea-molasses solution on chemical composition and in-vitro gas production. Dried, milled, and treated samples of maize-stover were used as T1 (untreated), T2 (0.5%), T3 (1%), T4 (1.5%), and T5 (2.0%).

The results of the study showed that crude protein (%) ranged from 2.76(T1) to 12.15(T5), crude fiber 20.17(T5) to 32.17(T1), ether extract 1.31(T1) to 3.05(T5), ash 10.90(T1) to 12.91(T5), NDF 62.26(T5) to 72.67(T1), ADF 41.18 (T5) to 48.16 (T1), and ADL 6.62(T5) to 9.98(T1) and were all significantly ( $P<0.05$ ) different. From (T1) to (T5), the hemicellulose and cellulose contents gradually dropped when more urea-molasses solution was added. The addition of more urea-molasses solution enhanced the insoluble but degradable percentage (b, ml) fermentation values ranged from 12.00 (T1) to 39.67 (T5). At 24 hours of incubation, treatment with urea-molasses had a significant ( $P<0.05$ ) impact on gas volume production (ml). T5 had the maximum gas volume measured at 46.67 milliliters, while T1 (20.67 ml) had the lowest. Across treatments, there was a significant ( $P<0.05$ ) difference in the calculated parameters. Short Chain Fatty Acid (SCFA, mmol) varied from 0.43(T1) to 1.05(T5), Metabolisable Energy (ME, MJ/Kg DM) ranged from 5.26(T1) to 9.29(T5), and Estimated Organic Matter Digestibility (OMD, %) ranged from 41.59(T1) to 70.24 (T5). According to the study's findings, treated maize stover with urea-molasses solution greatly increased the estimated values of OMD, ME, and SCFA. Adding treated maize-stover with urea-molasses to a full-feed-mixture is recommended for ruminants.

**Keywords:** Maize-stover, Urea-molasses solution, Chemical composition, *in vitro* gas production

## Description of problem

Inadequate feed has continued to be the principal barrier to livestock production in Nigeria and other developing nations. The main issue for livestock farmers has been

providing enough feed, both in terms of quantity and quality, particularly during times of scarcity, which are typically brought on by the dry season. For agricultural scientists and policy makers worldwide,

providing sufficient and high-quality feed to livestock in order to increase and sustain their production has been and will continue to be a significant concern (1).

In the tropics and sub-tropics, the issue of ruminant feeding has drawn a lot of attention (2). The main issue facing livestock farmers in developing nations has been the lack of a sufficient supply of feed, both in terms of quantity and quality. Because of this, numerous tactics have been developed to augment such shortages. Because the quantity and quality of feed available from natural pastures become limited in the late dry season, the majority of research efforts are focused on treating roughages (3). Each year, the annual cultivation of maize yields enormous amounts of stover, which are occasionally burned, mixed into the soil as fertilizer, or fed to animals. As the world's population grows, so does the amount of maize produced to meet demand, which in turn leads to an increase in the production of maize stover. Because of its low nutrient content and lignin content, feeding maize stover to cattle may meet the dietary needs of ruminants, but it cannot meet their nutritional needs. The nutritional content of maize stover may be enhanced by certain treatment. Prior studies used urea and fungal treatments, which were proven to be feasible on-farm and appropriate for low-income rural farmers (4). Many nations have given chemical upgrading of maize stover through ammoniation with gaseous or liquid ammonia a great deal of attention (5). Previous studies have shown an alternate ammoniation technique that uses urea as the ammonia source (6, 7, 8, 9, 10). Urea is not expensive in Nigeria and it is easy to obtain because fertilizer grade urea is readily available for sale.

Therefore, the goal of this work is to ascertain the changes in the chemical composition and *in vitro* gas production of maize stover treated with urea-molasses. The use of molasses was necessary to augment for the absence of energy in the urea. While many nations use large amounts of crop waste as feed, much more is still desired for a variety of uses or other purposes (11). Among its many other use, maize stover has established itself in the diet of ruminants. Crop leftovers are utilized as fuel, bedding for animals, substrate for mushroom growth, compost and mulch for crop production, and fiber for papermaking, according to studies (12). They can be used to build beds, fences, thatch roofs, and other things in underdeveloped nations. In order to solve the widespread scarcity of ruminant feeds in northern Nigeria during the dry season, the successful use of urea-molasses treatment of maize stover in Nigeria will be beneficial.

## Materials and methods

### Experimental site

The experiment was carried out in Yaba College of Technology, Epe campus, Lagos State. It is situated at latitude 6.58° N and longitude 3.98°E. It is 42m above the sea level along ijebu-ode Epe road on Km 16. Epe lies in lowland rain forest vegetation zone within the savannah agro ecological zone of southwest Nigeria (51)

### Sample collection and preparation

Samples of maize stover were cut into smaller pieces (about 1 cm) after being taken from the Yaba College of Technology's Teaching and Research Farm in Lagos. On 100g quadruplicate samples on DM bases, feed grade urea dissolved in water containing molasses equal to 0.5% (T2), 1.0% (T3),

1.5% (T4), and 2% T5 (w/v) was sprayed. While the samples needed for *in vitro* production and proximate composition were oven dried for six hours at 105°C to constant weight, the totally mixed samples were sun dried for seven days.

### Chemical Evaluations

Using the conventional Kjeldhal method, the nitrogen (N) content of the agricultural wastes was ascertained, and the amount of crude protein was computed ( $N \times 6.25$ ) (13). Standard techniques were used to evaluate crude fiber (CF), acid detergent lignin (ADL), neutral detergent fiber (NDF), and acid detergent lignin (ADF) (14).

### *In vitro* gas production

Three West African dwarf female goats had their rumen fluid extracted through the esophagus using a suction tube prior to morning feeding. In addition to 60% Guinea grass, the animals were fed 40% concentrate, 40% corn, 20% wheat offal, 10% palm kernel cake, 10% groundnut cake, 5% soybean meal, 10% brewer's grain, 1% common salt, 3.75% oyster shell, and 0.25% fishmeal. In three batches, 120ml calibrated syringes were incubated at 39°C in triplicate. The buffered rumen fluid (1:4, v/v) was continuously flushed with CO<sub>2</sub> while 30ml inoculums containing cheese cloth-strained rumen fluid and buffer (9.8g NaHCO<sub>3</sub> + 2.77g Na<sub>2</sub>HPO<sub>4</sub> + 0.57gKCl + 0.47gNaCl + 0.12gMgSO<sub>4</sub>.7H<sub>2</sub>O + 0.16g CaCl<sub>2</sub>.2H<sub>2</sub>O in a 1:4 v/v ratio) were added. Triplicate samples of blank was also incubated. Measurements were made of the gas output at 3, 6, 9, 12, 15, 18, 21, and 24 hours. To measure the amount of methane produced (15), 4 ml of NaOH (10 M) was added after the incubation period of 24 hours (16). The average volume of gas

generated from the blanks was deducted from the overall volume of gas produced. Fermentation characteristics were estimated using the equation. Y is the volume of gas formed at time t, and 'a' is the intercept (gas generated from the soluble fraction), b is the gas production rate constant for the insoluble fraction, and (a + b) The total volume of gas produced was subtracted from the typical volume of gas produced from the blanks. The equation was used to estimate fermentation properties  $Y = a + b(1 - e^{-ct})$  [17], as described elsewhere (18).

For the insoluble fraction (b), C is the gas generation rate constant, and t is the incubation time. Estimates were made for short chain fatty acids (SCFA), organic matter digestibility (OMD %),

And metabolisable energy (ME MJ/Kg DM) (18).

$$ME \text{ (MJ/kg DM)} = 2.20 + 0.136 * G_v + 0.057 * CP + 0.0029 * CF$$

$$(OMD \%) = 14.88 + 0.889 * G_v + 0.45 * CP + 0.651 * XA$$

$$SCFA = 0.0239 * G_v - 0.0601$$

Where G<sub>v</sub>, CP, CF, and XA represent the incubated sample's net gas production (ml/200 mg DM), crude protein, crude fiber, and ash, respectively while ME- metabolisable energy, SCFA-short chain fatty acid and OMD-organic matter digestibility.

### Statistical analysis

The acquired data were analyzed using analysis of variance (ANOVA), and the Statistical Analysis System (SAS) program and significant means separated using Duncan multiple range of the sample (19) and *in vitro* gas production characteristics were calculated using  $Y = a + b(1 - e^{-ct})$  (17).

## Results and Discussion

### Chemical Composition of Experimental Diets

The results obtained for chemical composition are displayed in Table 1. The crude protein value obtained for the treated samples differed from that of the untreated ones. The observed values (%) fall between 2.76 (T1) and 12.15 (T5). Treatment effects did, however, differ significantly from T2 to T5. The addition of nitrogen in the form of urea, non-protein nitrogen, may be the cause of the treated samples' improved CP content. Previous studies (20, 21) found that applying 0 and 7% feed grade urea to the samples resulted in an increase in CP content from 6% to 15%. Others (22, 4) noticed a slight increase in the urea-treated barley straw's CP content between 0 and 4% and the urea-treated maize cob's CP content between 0.5 and 2% respectively.

The percentage of crude fiber varied between 20.17 (T5) to 32.17% (T1). As the urea-molasses therapy was added in greater amounts, the CF dropped. This observation aligns with previous research (14), who applied varying urea concentrations to maize stover. The NDF, ADF, and ADL crude fiber fractions all showed the same pattern. Previous studies (23) claimed that ammoniation typically results in a decrease in crop residues' NDF and hemicellulose levels. This observation aligns with the findings of this investigation. The solubilization of hemicelluloses may be the cause of the lower NDF value in this investigation (24). According to others (4), urea solution ammoniated *Brachiaria humidicola* hay at 6% reduced its NDF content as compared to untreated hay.

**Table 1: Chemical composition (g/100gm DM) of urea-molasses treated maize stover**

| Parameters | Treatments         |                    |                    |                    |                    | SEM  |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
|            | T1                 | T2                 | T3                 | T4                 | T5                 |      |
| CP         | 2.76 <sup>b</sup>  | 11.05 <sup>a</sup> | 11.95 <sup>a</sup> | 12.06 <sup>a</sup> | 12.15 <sup>a</sup> | 0.26 |
| CF         | 32.17 <sup>a</sup> | 25.02 <sup>b</sup> | 20.67 <sup>c</sup> | 19.46 <sup>e</sup> | 20.17 <sup>d</sup> | 0.01 |
| EE         | 1.31 <sup>d</sup>  | 2.27 <sup>c</sup>  | 2.94 <sup>b</sup>  | 3.0 <sup>ab</sup>  | 3.05 <sup>a</sup>  | 0.02 |
| Ash        | 10.9 <sup>c</sup>  | 12.01 <sup>b</sup> | 12.79 <sup>a</sup> | 12.80 <sup>a</sup> | 12.91 <sup>a</sup> | 0.04 |
| NFE        | 52.86 <sup>a</sup> | 49.65 <sup>b</sup> | 51.65 <sup>a</sup> | 52.68 <sup>a</sup> | 51.72 <sup>a</sup> | 0.24 |
| NDF        | 72.67 <sup>a</sup> | 68.45 <sup>b</sup> | 66.92 <sup>c</sup> | 65.72 <sup>d</sup> | 62.26 <sup>e</sup> | 0.01 |
| ADL        | 9.83 <sup>a</sup>  | 8.82 <sup>b</sup>  | 7.88 <sup>c</sup>  | 7.04 <sup>a</sup>  | 6.62 <sup>e</sup>  | 0.01 |
| ADF        | 48.16 <sup>a</sup> | 45.36 <sup>b</sup> | 44.36 <sup>c</sup> | 43.67 <sup>a</sup> | 41.18 <sup>e</sup> | 0.01 |
| Hemicel    | 24.51 <sup>a</sup> | 23.09 <sup>b</sup> | 22.56 <sup>c</sup> | 22.05 <sup>d</sup> | 21.08 <sup>e</sup> | 0.24 |
| Cell.      | 38.33 <sup>a</sup> | 36.54 <sup>c</sup> | 37.32 <sup>b</sup> | 35.79 <sup>d</sup> | 34.56 <sup>e</sup> | 0.14 |

<sup>a-c</sup> Means on the same row with different superscripts are significantly different ( $p < 0.05$ ).

SEM=Standard error of mean. T1= untreated, Hemicel=hemicellulose; Cell. = cellulose

**Table 2:** *In Vitro* gas production (ml/200gDm) and gas production characteristics of urea-molasses treated maize stover

| Treatment      | Incubation hrs     |                    |                     |                     |                    |                    |                    |                    |
|----------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|
|                | 3                  | 6                  | 9                   | 12                  | 15                 | 18                 | 21                 | 24                 |
| T <sub>1</sub> | 9.33 <sup>c</sup>  | 12.00 <sup>b</sup> | 14.00 <sup>c</sup>  | 16.0 <sup>c</sup>   | 16.0 <sup>d</sup>  | 18.0 <sup>d</sup>  | 19.33 <sup>d</sup> | 20.67 <sup>d</sup> |
| T <sub>2</sub> | 14.00 <sup>b</sup> | 16.67 <sup>b</sup> | 18.67 <sup>c</sup>  | 19.33 <sup>c</sup>  | 21.33 <sup>c</sup> | 25.33 <sup>c</sup> | 28.67 <sup>c</sup> | 31.33 <sup>c</sup> |
| T <sub>3</sub> | 18.67 <sup>b</sup> | 17.33 <sup>b</sup> | 24.67 <sup>b</sup>  | 26.67 <sup>b</sup>  | 28.67 <sup>b</sup> | 31.33 <sup>b</sup> | 32.67 <sup>b</sup> | 38.00 <sup>b</sup> |
| T <sub>4</sub> | 17.33 <sup>b</sup> | 25.33 <sup>b</sup> | 29.33 <sup>ab</sup> | 31.33 <sup>ab</sup> | 34.00 <sup>a</sup> | 35.67 <sup>a</sup> | 37.33 <sup>a</sup> | 41.33 <sup>b</sup> |
| T <sub>5</sub> | 29.33 <sup>b</sup> | 31.33 <sup>a</sup> | 32.67 <sup>a</sup>  | 33.00 <sup>a</sup>  | 35.33 <sup>a</sup> | 38.67 <sup>a</sup> | 40.67 <sup>a</sup> | 46.67 <sup>a</sup> |
| SEM            | 0.85               | 1.13               | 0.1                 | 0.91                | 0.89               | 0.79               | 0.71               | 0.62               |

<sup>a-d</sup> Means on the same row with different superscripts are significantly different ( $p < 0.05$ ), T<sub>1</sub> = control SEM = Standard error of mean. T<sub>1</sub> (0%), T<sub>2</sub> (0.5%), T<sub>3</sub> (1.0%), T<sub>4</sub> (1.5%) and T<sub>5</sub> (2%)

*In vitro* gas production and estimated ME, OMD and SCFA

The output of gas production over a 24-hour period is shown in Table 2. Significant difference ( $p < 0.05$ ) was observed in the gas volume produced at different levels of incubation, with greater quantities recorded in the treated samples. T<sub>5</sub> > T<sub>4</sub> > T<sub>3</sub> > T<sub>2</sub> > T<sub>1</sub> was the gas volume at 24 hours,

Listed from the highest to lowest.

#### Gas Production over Time

The results of the urea-molasses treated maize stover in the *in vitro* gas production (Table 2) indicate ( $P < 0.05$ ) difference in the gas production profile over the 24-hour incubation period (25). The fermentation process, as the rumen microbes broke down the maize stover, was reflected in the overall pattern of rising gas production over time, with higher gas production correlating with enhanced microbial activity (26).

At the earliest time point (3 hours), gas production from all treatments was relatively low, ranging from 9.33 ml (T<sub>1</sub>) to 29.33 ml (T<sub>5</sub>), with significant variation between treatments (27). By the 24-hour mark, gas production peaked for all treatments, with T<sub>5</sub> producing the highest volume (46.67 ml), followed by T<sub>4</sub> (41.33 ml), T<sub>3</sub> (38.00 ml), T<sub>2</sub>

(31.33 ml), and T<sub>1</sub> (20.67 ml) (28). These results align with findings by (29), where increased nitrogen availability from urea and fermentable carbohydrates from molasses improved ruminal fermentation and gas production in similar treatments.

The data shows that treatments with higher levels of urea and molasses (T<sub>5</sub> and T<sub>4</sub>) consistently produced more gas over time, suggesting that these treatments were more fermentable. This is consistent with previous studies (30), which demonstrated that urea supplementation increases microbial protein synthesis, leading to greater gas production as a result of enhanced microbial growth and activity.

#### Individual Treatment Observations

1. T<sub>1</sub> (Control): As expected, the untreated maize stover (T<sub>1</sub>) displayed the lowest gas output throughout all time points. The reduced gas production suggests limited fermentability, likely due to the high lignin content and reduced availability of fermentable carbohydrates (31). Similar results were observed in studies where untreated stover had low gas production, indicating poor digestibility (32).

2. T2: Over the course of the incubation period, treatment T2 showed a consistent increase in gas production, suggesting that urea-molasses treatment improved the fermentability of maize stover (33). The higher gas production compared to T1 indicates that the urea-molasses treatment likely enhanced the availability of soluble carbohydrates and nitrogen, which promoted microbial fermentation (34).
3. T3: T3 exhibited an intermediate response, producing considerable amounts of gas after 12 hours of incubation. This suggests that the treatment, while effective, may require a longer incubation period to fully express its benefits on fermentability (35). This pattern is consistent with studies that suggest a delayed but significant response to urea-molasses treatment (36).
4. T4: Treatment T4 produced the second-highest volume of gas (41.33 ml), suggesting that this specific urea-molasses ratio was highly effective in improving microbial fermentation and maize stover digestibility (30). Similar outcomes were reported by (37), who found that optimized urea-molasses treatments significantly increased fermentation efficiency and gas production in lignocellulosic materials.
5. T5: The most significant rise in gas production was observed in T5, which is the treatment with highest levels of urea and molasses inclusion. This suggests that enhanced microbial fermentation resulted from increased nitrogen availability from urea and fermentable sugars from molasses, making the maize stover more palatable and energetically

valuable to ruminants (27, 30). Studies by (25) and (28) support the notion that higher urea and molasses content significantly boosts microbial fermentation and the digestibility of fibrous plant materials.

### Gas Production Characteristics

The fermentative potential of each treatment can be inferred from its gas production characteristics. Higher gas production generally indicates better digestibility and, therefore, higher-quality fodder (38). These findings align with studies suggesting that treatments such as urea-molasses improve the fermentability of low-quality forages, ultimately enhancing their nutritional value for ruminants (31,30).

The notable differences in gas production between treatments, particularly between T5 and T1, indicate that low-quality roughages like maize stover can benefit from urea-molasses treatment, improving their nutritional profile (36). Such treatments can be valuable in animal feeding systems to improve fiber digestion and energy availability (29,27).

The calculated ME, OMD, SCFA, fermentation of the insoluble but degradable component (b, ml), and methane (CH<sub>4</sub>) are displayed on Table 3. The greatest values were found for Estimated OMD (%) in T5 (12). Wide differences were observed in the study's OMD values, which improved as the urea-molasses concentration rose. The positive outcomes of the urea treatment may be responsible for this improvement. According to research, rumen microorganisms can easily utilize the nitrogen that is introduced during treatment (12). Throughout the entire treatment, the estimated ME and SCFA has improved. The

SCFA is a measure of the ruminants' energy availability. The activity of urea and molasses may be linked to the improvement in ME and SCFA observed in this study. Molasses and other fermentable energy additions have the potential to improve the efficiency of urea nitrogen incorporation into microbial protein in the rumen.

Ammonia produced during urea treatment has the following effects: it dissolves parietal carbohydrates, primarily hemicelluloses; it increases the amount of vegetative matter in an aqueous environment, allowing rumen cellulolytic microbes to access it; and it enriches the nitrogen content of forage (30). This could partially account for the enhanced CP, OMD, ME, and SCFA.

**Table 3:** Estimated metabolizable energy (ME), organic matter digestibility (OMD), short chain fatty acid (SCFA) and methane gas

| Treatment      | PARAMETERS         |                   |                     |                 |                   |
|----------------|--------------------|-------------------|---------------------|-----------------|-------------------|
|                | OMD                | SCFA              | B                   | CH <sub>4</sub> | ME                |
| T <sub>1</sub> | 41.59 <sup>d</sup> | 0.43 <sup>d</sup> | 12.00 <sup>d</sup>  | 13 <sup>a</sup> | 5.26 <sup>d</sup> |
| T <sub>2</sub> | 55.53 <sup>c</sup> | 0.69 <sup>c</sup> | 25.33 <sup>c</sup>  | 11ab            | 7.16 <sup>c</sup> |
| T <sub>3</sub> | 62.36 <sup>b</sup> | 0.85 <sup>b</sup> | 33.00 <sup>b</sup>  | 8 <sup>b</sup>  | 8.11 <sup>b</sup> |
| T <sub>4</sub> | 65.39 <sup>b</sup> | 0.93 <sup>b</sup> | 35.33 <sup>ab</sup> | 6 <sup>b</sup>  | 8.57 <sup>b</sup> |
| T <sub>5</sub> | 70.24 <sup>a</sup> | 1.05 <sup>a</sup> | 39.67 <sup>a</sup>  | 6 <sup>b</sup>  | 9.29 <sup>a</sup> |
| SEM            | 0.59               | 0.01              | 0.99                | 0.89            | 0.09              |

a-c Means on the same row with different superscripts are significantly different ( $p < 0.05$ ). SEM=Standard error of mean. ME=Metabolizable energy, OMD= Organic matter digestibility, SCFA= Short chain fatty acid, CH<sub>4</sub>= Methane, Feed grade urea dissolved in water containing molasses equivalent to 0.5% (T<sub>2</sub>), 1.0% (T<sub>3</sub>), 1.5% (T<sub>4</sub>) and 2% T<sub>5</sub> (w/v), T<sub>1</sub>=control

Since lignin prevents rumen microorganisms from breaking down carbohydrates, it is one of the primary causes of the untreated stover's poor digestibility. However, the treatment eliminated this. When feedstock is incubated in vitro with buffered rumen fluid, the carbohydrates ferment to produce microbial cells, gases (mostly CO<sub>2</sub> and CH<sub>4</sub>), and short chain fatty acids (SCFA) (39). The overall amount of gas produced (40) demonstrated significant differences in the functionalities of carbohydrates, primarily due to the fermentation of carbohydrates into acetate,

#### **Propionate and butyrate (41).**

Protein fermentation produces very little gas in comparison to carbohydrate fermentation, while fat makes very little gas (42). The gas produced by the samples incubated in buffered rumen is connected to SCFA in this experiment, which was based on carbohydrate fermentations (43). According to others (44), there is a strong correlation between SCFA and the generation of in vitro gas. This correlation can be used to forecast SCFA, which is a measure of the animals' availability of energy.

Research (45, 40, 18) confirmed that relying solely on gas and chemical ingredients for the prediction of ME results in a higher degree of accuracy. Furthermore, there are relationships between in vivo digestibility

and in vitro gas measurement. ME values of traditional feeds assessed in vivo have a positive association with CP and fat content, as well as with ME computed from in vitro gas production(18).

**Table 4:** Kinetic fermentation of Urea-molasses treated maize stover

| treatment | Parameters       |                    |                     |                    |
|-----------|------------------|--------------------|---------------------|--------------------|
|           | a (ml)           | b (ml)             | c (ml/hr)           | a+b (ml)           |
| T1        | 8.0 <sup>a</sup> | 12.00 <sup>c</sup> | 0.0014 <sup>d</sup> | 20.67 <sup>d</sup> |
| T2        | 6.0 <sup>c</sup> | 25.33 <sup>d</sup> | 0.0078 <sup>c</sup> | 31.33 <sup>c</sup> |
| T3        | 5.0 <sup>d</sup> | 33.00 <sup>c</sup> | 0.0081 <sup>b</sup> | 38.00 <sup>b</sup> |
| T4        | 6.0 <sup>c</sup> | 35.33 <sup>b</sup> | 0.0084 <sup>b</sup> | 41.33 <sup>b</sup> |
| T5        | 7.0 <sup>b</sup> | 39.67 <sup>a</sup> | 0.0091 <sup>a</sup> | 46.67 <sup>a</sup> |
| SEM       | 0.42             | 0.01               | 0.01                | 0.62               |

a-d Different superscripted means on the same row differ significantly ( $p < 0.05$ ). (a + b) = total gas generated; C = gas production rate constant for the insoluble fraction; a = intercept (gas produced from the soluble fraction); b = gas production rate constant for the insoluble fraction; (b), SEM=Standard error of mean, T1=control

Table 4's kinetic fermentation parameters for maize stover treated with urea-molasses demonstrate notable differences between the treatments. The initial fermentation volume (a), final fermentation volume (b), gas production rate (c), and total gas production volume (a + b) are some of these parameters. The results suggest that urea-molasses treatment has a notable effect on the fermentation dynamics and chemical composition of maize stover, which may contribute to enhanced digestibility and overall feed quality.

Initial and Final Fermentation Volumes (a and b)

Between treatments, there were notable differences in the initial fermentation volume (a). With the smallest starting volume in T1 (8.0 ml) differed greatly from the others. The initial fermentation volume rose with increasing treatment levels (from T1 to T5), with T5 showing the highest value (7.0 ml). According to this pattern, larger

concentrations of urea-molasses might facilitate a quicker initial fermentation process, which might be connected to more fermentable substrates (such sugar and nitrogen) being available in the maize stover. Likewise, there were notable differences in the end fermentation volumes (b) between treatments, with T5 producing the largest final volume at 39.67 ml. T1 had the lowest final fermentation volume (12.00 ml), in contrast. The rise in b from T1 to T5 indicates that the urea-molasses treatment improves the microbial fermentation capacity of maize stover. This could be because the sugars from molasses and the nitrogen addition from urea lead to improved microbial activity. Researchers, (46) found that the urea-molasses treatment enhanced the fermentative qualities of low-quality forages, including a rise in microbial fermentation. This observation is consistent with their findings.

### Rate of Gas Production ©

The urea-molasses treatment also had a substantial impact on the rate of gas production (c), with values gradually rising from T1 to T5. At 0.0014 ml/hr, treatment T1 had the lowest gas generation rate, while treatment T5 had the highest at 0.0091 ml/hr. The treated maize stover's increased digestibility and enhanced microbial activity are correlated with this rise in gas generation rate. The increased rate of fermentation in treatments containing more urea and molasses points to improved microbial fermentation kinetics, which may be the result of improved microbial biomass formation and nitrogen use (47). These findings corroborate earlier studies, including one by (48), which discovered that adding urea-molasses solutions to feed substrates boosts fermentation efficiency and encourages the development of cellulolytic microorganisms.

### Total Gas Volume (a+b)

The beneficial effect of urea-molasses treatment on fermentation is further demonstrated by the total amount of gas generated, which is shown by a + b. At 46.67 ml, treatment T5 produced the most gas overall, followed by T4 (41.33 ml) and T3 (38.00 ml). On the other hand, T1 produced the least amount of gas overall (20.67 ml). The higher gas production in higher treatments implies that the urea-molasses solution aids in the breakdown of cellulose and hemicellulose, two structural elements in the stover, enabling more effective fermentation. These results are in line with earlier research by (49), who observed that treating fibrous materials with urea-molasses improves their chemical makeup and increases the amount of fermentable nutrients available, thereby enhancing their

fermentability.

Higher urea-molasses concentrations have been shown to boost gas generation, which is a sign of better fermentation and is frequently associated with higher digestibility in ruminant animals. By improving the availability of nutrients, especially nitrogen, for microbial growth and fermentation, the improved fermentation kinetics of maize stover treated with urea and molasses probably promote greater feed utilization. The results of this investigation are consistent with those of (50), who discovered that treating forages with urea-molasses enhanced their chemical makeup and in vitro digestibility. T5 may have the highest chance of enhancing the nutritional value and fermentability of maize stover due to the increased gas production seen in this treatment.

The urea-molasses treatment greatly enhanced the maize stover's fermentation kinetics, with higher treatment levels (T5) producing the best outcomes in terms of both fermentation rate and total gas output. These enhancements suggest that treating maize stover with urea-molasses may increase its chemical makeup and digestibility, increasing its value as a feed source for ruminant animals. In addition to optimizing the urea-molasses ratio for various forage types, future research should examine the long-term impacts of these treatments on animal performance and nutrient use.

## Conclusion and application

### Conclusion

Treatment as affected by increased protein content, decreased fiber content, and increased digestibility, the urea-molasses treatment greatly increased the nutritional value of maize husk with T5 having the best

result. The estimation of short-chain fatty acids, the digestibility of organic matter, and metabolizable energy were all positively affected by the treatment. Application of the study's conclusions have important ramifications for sustainable agriculture and animal nutrition:

1. Better Ruminant Feed: During times of feed scarcity or high feed costs, urea-molasses treated maize husk can be utilized as a valuable feed element for ruminants.
2. Improved Nutrient Utilization: The treated husk's higher digestibility and nutrient content can help ruminants use nutrients more effectively overall, which will boost their growth and milk output.
3. Less Environmental Impact: Farmers can lessen their dependency on pricey commercial feeds and their environmental impact by using a cheap, locally accessible feed resource, such as maize husk.
4. Research Potential: This work offers a strong basis for further investigations into the best treatment circumstances and the long-term impacts of treating corn husk with urea-molasses on animal performance.

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