The Effect of Molasses Levels on Quality of Sorghum (*Sorghum bicolor*) Silage

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**Abstract:** This experiment was conducted to study the effect of the addition of graded levels of molasses on quality of fermentation and nutritive value of sorghum silage. Four samples were made, 0.0% (control), 5%, 10% and 15% molasses. The samples were mixed, packed in laboratory silos (glass jar 1 kg in volume) and stored room temperature about 25°C for 25 days. Chemical composition, pH, color, smell and texture of the silage were studied. In vitro gas production was carried out. In vitro organic matter digestibility (IVOMD) and metabolic energy (ME) were calculated. CP and Ash were significantly (p<0.05) increased due to increase in molasses levels. While ADF and NDF were decreased significantly (p<0.05). Increase in molasses levels improved the gas production parameters (a), (b), (a+b) and (c). IVOMD and ME were significantly (p<0.05) improved. ADF and NDF were positively correlated with (a) and negatively with (b), (a+b) and (c).

**Keywords:** Sorghum, Ensilage, Molasses and In vitro gas production

**INTRODUCTION**

Ensiling is an important technique not only for the winter season in cold and temperate zones but also for dry season in the tropical zone to make a good use of plant material (some times produced in excess) with the highest nutritive value. It is based on natural fermentation whereby lactic acid bacteria ferment sugars mainly to lactic acid under anaerobic environment. In this condition silages can be preserved over long periods of time without spoilage 

Silage additives include feedstuffs, urea, ammonia, inoculants and acids. Their main functions are to either increase nutritional value of silage or improve fermentation so that storage losses are reduced. Molasses has been used as a fermentation stimulant for many years and recently there has been a renewed interest in its use. Molasses provides a relatively cheap source of fermentable carbohydrate for lactic acid bacteria. Molasses in numerous silage experiments has been proven to be an effective silage additive in terms of promoting lactic fermentation, reducing silage pH, discouraging a clostridial fermentation and proteolysis, and generally decreasing organic matter losses.

Sudan have five factories producing sugar from sugar cane one of them (Kenana) is the most biggest in Africa, therefore molasses is produced in abundant quantity. Some of this molasses must be efficiently used in animal feed.

The main objective of this experiment is to study the effect of addition of different levels of molasses on sorghum silage quality in term of physical characteristics, chemical composition, and its relationship with the gas production parameters, in vitro organic matter digestibility (IVOMD) and metabolic energy (ME).

**MATERIALS AND METHODS**

Sorghum (Abu 70) at milk stage was harvested, then chopped in ⅝ - ⅜ inch and divided, molasses was added at 0.0% as a control, 5.0%, 10.0% and 15.0% w/w. The four samples were mixed, packed by hand with gentle compression in laboratory silos (glass jar 1 kg in volume) to reduce the air in the silo, rapidly closed and stored under roof into laboratory, the ambient temperature about 25°C for 25 days.

**Color, Smell and Texture:** The data were collected by Questionnaire in the last day and tested according to 

**Gas Trial:** Dried samples 200 mg of each treatment were incubated with rumen liquor and buffering solution (1:3) into calibrated glass syringes (100ml), in water bath, the temperature was 39 ± 0.5°C. The volumes of gas were measured and recorded at zero, 3, 6, 12, 24, 48, 72 and 96 hours. Cumulative gas production data were fitted to the model of Orskov and McDonald 

\[ Y = a + b \left(1 - \exp^{-ct}\right) \]
Where:

- $a$ = the gas production from the immediately soluble fraction (ml)
- $b$ = the gas production from the insoluble fraction (ml)
- $a + b$ = the potential gas production
- $c$ = the gas production rate
- $t$ = incubation time (h)
- $y$ = gas production at time $(t)$

The OMD of silage was calculated using equation of Menke et al., as:

$$OMD \, (\%) = 14.88 + 0.889GP + 0.45CP + XA$$

Where:

- $GP$ = is 24 h net gas production (ml / 200 mg)
- $CP$ = Crude protein (%)
- $XA$ = Ash content (%)

ME (MJ/Kg DM) content of silage was calculated using equation of Menke et al., as follows:

$$ME \, (MJ/kg \, DM) = 2.20 + 0.136GP + 0.057CP + 0.0029CP^2$$

Where:

- $GP$ = is 24 h net gas production (ml/200mg)
- $CP$ = crude protein

**Laboratory Analysis:** pH was estimate by pH meter, the chemical composition of the silage crude protein (CP) and Ash were determined according to [3]. Acid detergent fiber (ADF) and Natural detergent fiber (NDF) were determined according to [20].

**Statistical Analyses:** The data obtained were subjected to analyses of variance according to the complete randomized design [17], means were compared using least significant difference LSD procedure of the Statistica.

**RESULTS AND DISCUSSIONS**

**Results:**

**pH:** Generally increases in molasses levels in the sorghum silage, was significantly ($p < 0.05$) lead to drop in the pH Table (1).

**Color, Smell and Texture:** In table 2 the color and smell were significantly ($p < 0.05$) improved with increased molasses levels. Green yellow colour and the pleasant and sweet acidic smell were observed in 15% molasses.

**The Chemical Composition of Silage:** The crude protein content increased significantly ($p < 0.05$) with increase molasses levels. The high value 7.88 was shown in 15% molasses and the low value 6.54 recorded in the control (zero% molasses). The Ash generally increased due to increase in the level of molasses, the high Ash content 9.3% was found in 15% molasses and low value 8.23% in control 0.0% molasses (table 3).

Acid detergent fiber ADF and Neutral detergent fiber NDF were significantly ($p < 0.05$) decreased with increase levels of molasses (table 3).

**Gas Production Characteristics:** In this study increased molasses levels resulted in increase of the gas production. Fraction (a), gas produced from quickly degradable part were significantly ($p < 0.05$) increased due to the increase in the level of molasses. Similarly fraction (b), gas produced from slowly degradable part and the potential gas production $(a + b)$ were increased due to addition of molasses. Where as in this study it
was found that the three molasses levels 5\%, 10\% and 15\% have significantly (p < 0.05) higher gas production rate fraction (c) than the control treatment (table 4).

**Organic Matter Digestibility and Metabolizable Energy:** The organic matter digestibility and metabolizable energy increased significantly (p<0.05) with addition of molasses when compared to zero molasses level (control) (table 4).

**Correlation Between ADF and NDF with Gas Production Fractions:** There was significant (p < 0.03) positive relationship between (ADF and NDF) and quickly degradable fraction (a).

ADF and NDF were negatively correlated with (b), (a + b) and (c) fraction (table 5).

**Discussion:** In this study the pH lowest value 4.21 was in 15 percent molasses which is expected due to improve the activity of lactic acid bacteria to produce lactic acid and discourage the clostridia.

This agreed with Becker\[5\], Henderson\[6\], Tosi et al.\[10\], Keady\[7\] and Liu and Guo\[8\]. Who found that addition of molasses to silage decreased the pH.

The color and smell were improved with increase molasses levels. A high score of color was 20 and smell was 25 were observed in 15\% molasses. This score classified silage as good quality. This is inconsistent with finding of Nguyen et al.\[14\].

ADF and NDF decreased with increase molasses levels because molasses have little ADF and NDF content, these results were inconsistent with Nayighugu et al.\[11\]. In contrast ash was increased with increase levels of molasses due to the high mineral content in molasses. This results revealed significantly (P<0.05) higher value of CP 7.88\% in 15\% molasses than 6.54\% in control (zero molasses).

This finding was similar to that found by Aksu et al.\[21\]. The all estimated parameters of gas production fraction (a), (b), (a+b) and (c) were increased with the addition of molasses. The in vitro organic matter digestibility (IVOMD) and metabolizable energy (ME) were significantly (p<0.05) improved due to addition of molasses, these results were inconsistent with results of Tugba et al.\[22\], Samie et al.\[16\] and Mehtab et al.\[10\]. The relationship between quickly degradable fraction (a) with ADF and NDF showed positive effect, this agreed with Ndlovu and Nolodovu and Nherera\[13\].

In this study the Acid detergent fiber (ADF) and Neutral detergent fiber (NDF) had negative relationship with (b), (a + b) and (c) i.e decreased ADF and NDF content lead to high gas production this might have occurred due to increase microbial activity by giving soluble carbohydrate source (molasses ), this supported by Abreu and Bruno\[11\], and Wood and Plump\[21\].

**Conclusion:** This result concluded that the addition of molasses improved the quality of sorghum forage silage in terms of physical properties, chemical composition,
in vitro organic matter digestibility, metabolic energy and fermentation activities.

REFERENCES


