EFFECT OF ENSILING ELEPHANT GRASS WITH MOLASSES ON THE NUTRITIVE VALUE AND *IN-VITRO* DIGESTIBILITY

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ABSTRACT
Ensiling is the process of preserving a forage crop and its nutrients to be fed later on as silage. In this study, elephant grass was ensiled with varying levels of molasses as additive to evaluate its effect on the nutritive value and in-vitro digestibility of the silage. Four treatments of Pennisetum purpureum grass silage were produced with molasses at 0 (T1), 2.5 (T2), 5 (T3) and 7.5% (T4) inclusion levels. Silages containing inclusions of molasses (T2, T3 and T4) had higher contents of dry matter (71.4-73.10%), crude protein (10.15-12.15%) and nitrogen-free extract (21.05-23.43) than T1. All the fibre fractions such as acid detergent fibre, neutral detergent fibre, acid detergent lignin, cellulose and hemicellulose contents were lower in silage containing molasses as additive (T2, T3 and T4). At 6 and 15 hours incubation, there were no significant differences (p>0.05) in the in-vitro gas production. However, gas production was significantly higher (p<0.05) in silages with inclusion of molasses additives (T2, T3 and T4) at 9 (23.33-28.00), 12 (28.00-34.00), 18 (30.33-38.00), 21 (33.00-38.67) and 24 (34.00-40.33) hours of incubation. Conspicuously, silages containing graded levels of molasses as additive had significantly higher (p<0.05) methane gas, carbon dioxide, gas volumes, in-vitro digestibility, metabolisable energy and organic matter digestibility than the control silage.
It could be concluded that inclusion of graded levels of molasses as additives in elephant grass silage led to higher nutrient contents, increased in-vitro gas production as well in-vitro dry matter digestibility and reduced fibre fraction of silage
Keywords: Molasses, Nutritive value, *In-vitro* digestibility, Elephant grass, Silage.

INTRODUCTION
The constraint for profitable livestock production in developing countries is the uneven and insufficient supply of quality forage (Binuomote *et al*., 2019). The availability of green forage is seasonal, mostly in rainy season, when plant growth is high. The seasonal scarcity can considerably be reduced by conserving the surplus forage during high fodder availability period. Ensiling is the process of preserving a forage crop and its nutrients to feed later to animals. According to Kung *et al*. (2000), the primary purpose of making silage is to maximize the preservation of original nutrients in the forage crop for feeding at a later date. Silage is a method of forage preservation through stabilizing fermentation process by decreasing the pH within minimum fermentation period. Low pH is usually accomplished through the fermentation of sugars in the crop to lactic acid by lactic acid bacteria, which decreases plant enzyme activity and prevents the proliferation of detrimental anaerobic microorganisms, especially clostridia and enterobacteria (Yang *et al*., 2004). Among the non-grain grasses used in silage production, the elephant grass (*Pennisetum purpureum*) stands out as forage with an excellent potential for dry matter production and with a high amount of soluble carbohydrates (Santos *et al*., 2013). Elephant grass has low concentrations of fermentable carbohydrates and the addition of additives can improve the quality of its silage (Iqbal *et al*., 2005). Molasses enriches the fresh material with carbohydrates and fills the gaseous pores, thereby reducing the influx of oxygen in the silage. Using molasses as additive can increase the amount of fermentation end products due to fermentation of the available sugars in the molasses (Yakota *et al*., 1992). Hence, this study evaluated the effect of molasses as additive on the chemical composition, *in-vitro* gas production and dry matter digestibility of elephant grass silage.

MATERIALS AND METHODS

Experimental site and design

The study was carried out at the Animal Science section of the Teaching and Research Farm of Osun State University, College of Agriculture, Ejigbo Campus, Osun State. The experiment was arranged in a Completely Randomized Design (CRD) with four replicate plots. There were four treatments: T1-Control (no molasses), T2- 2.5% molasses, T3- 5% molasses and T4- 7.5% molasses.

Silage production

Elephant grass field was cut back and thereafter allowed to regrow and then harvested at 4 weeks of age, wilted, chopped into chips of 3cm and weighed. Molasses was added at 0, 2.5, 5 and 7.5% inclusion levels, thoroughly mixed and consolidated, then stacked and compressed into bucket silo and sealed air-tight for 3 weeks.

Chemical analysis

Oven dried samples were ground through 1mm sieve and were analyzed for proximate analysis (AOAC 2000) while fibre contents were determined using the procedure of Van Soest *et al*. (1991).

In-Vitro Dry matter Digestibility

The silage samples were analyzed for *in-vitro* DM digestibility according to the method of Tilley and Terry (1963). Rumen contents were squeezed through four layer of cheese cloth kept in water bath at $39^{O}C$ until incubation takes place. Representative samples of the mixtures (2.5g DM) were taken in a separate bottle having 0.05 litres rumen liquor 0.2 litres buffer solution (Buffer solution: KCl 0.57 g/L, $MgSO_4$. $7H_2O$ 0.12 g/L, NaCl 0.47 g/L, $CaCl_2$ 0.04 g/L, $Na_2HPO_4.12H_2O$ 9.30 g/L, $NaHCO_3$ 9.80 g/L, Cysteine 0.25 g/L (Elmenofy *et al*., 2012, Tilley and Terry, 1963). The bottles were kept in water bath at $39^{O}C$. The samples were run for *in-vitro* dry matter digestibility at 6, 9, 12, 15, 18, 21 and 24 hours of incubation.

Data analysis

The data collected were subjected to one way analysis of variance procedure of the General Linear Model (SAS 2008). Significant means were separated using the Duncan New Multiple Range Test.

RESULTS

Silages containing inclusions of molasses (T2, T3 and T4) had higher contents of dry matter (71.4-73.10%), crude protein (10.15-12.15%) and nitrogen-free extract (21.05-23.43%) than T1 (Table 1). However, these silages had relatively lower crude fibre content (24.55-25.90%), acid detergent fibre (45.50-46.90%), neutral detergent fibre (64.60-65.80%), acid detergent lignin (21.89-22.70%), cellulose (21.43-23.58) and hemicellulose (11.18-13.63). All the fibre fractions such as acid detergent fibre, neutral detergent fibre, acid detergent lignin, cellulose and hemicellulose contents were lower in silage containing molasses as additive (T2, T3 and T4), that is, as the graded levels of molasses increased the fibre contents decreased while higher fibre contents was recorded in silage without molasses.

Table 1: Chemical composition of elephant grass silage

Parameters (%)	T1	T2	T3	T4
Dry matter	71.75	71.40	72.88	73.10
Crude protein	9.95	10.15	11.88	12.15
Crude fibre	26.30	25.90	24.55	25.10
Ether extract	2.25	2.29	2.11	2.20
Ash	11.89	12.01	10.91	11.44
Nitrogen free extract	21.36	21.05	23.43	22.21
Fibre Fractions				
Acid detergent fibre	48.50	46.90	45.50	46.10
Neutral detergent fibre	67.10	65.10	64.60	65.80
Acid detergent lignin	23.10	22.70	21.80	22.60
Cellulose content	26.43	23.58	22.36	21.43
Hemicellulose content	17.04	13.63	12.59	11.18

At 6 and 15hours incubation, there were no significant differences ($p>0.05$) in the means of *invitro* gas production (Table 2). However, gas production was significantly higher ($p<0.05$) in silages with inclusion of molasses additives (T2, T3 and T4) at 9 (23.33-28.00), 12 (28.00-34.00), 18 (30.33-38.00), 21 (33.00-38.67) and 24 (34.00-40.33) hours of incubation. Conspicuously, silages containing graded levels of molasses as additive had significantly higher ($p<0.05$) methane gas, carbon dioxide, gas volumes, *in-vitro* digestibility, metabolisable energy and organic matter digestibility than the silage without molasses (control).

DISCUSSION

The dry matter (DM) in this study was greater than the values reported by Alabi *et al*. (2019). This might be attributed to the differences in the season of harvest. Crude fibre (CF) decreased with increased inclusion of molasses in the silage which could be as a result of effect of molasses and period of ensiling. The CP obtained in the study was above the critical value recommended for small ruminants (NRC, 2001). The ADF was similar to the values reported by Pirmohammadi *et al*. (2006).

Table 2: *In-vitro* gas production of elephant grass silage with molasses

Parameters	T1	T2	T3	T4	P-value
6hrs	13.67	14.00	17.33	16.67	0.2403
9hrs	21.00^{b}	23.33^{ab}	24.33^{ab}	28.00^{a}	0.0576
12hrs	25.00^{b}	28.00^{ab}	31.67^{ab}	34.00^{a}	0.0785
15hrs	27.00	28.67	34.00	35.67	0.1387
18hrs	27.67^{c}	30.33^{bc}	36.00^{ab}	38.00^{a}	0.0266
21hrs	29.67^{b}	33.00^{ab}	38.33^{a}	38.67^{a}	0.0499
24hrs	32.67^{b}	34.00^{ab}	40.33^{a}	38.67^{ab}	0.0569
Methane gas (CH_4)	18.33^{b}	20.67^{b}	26.33^{a}	25.33^{a}	0.0071
Carbon dioxide (CO_2)	13.67	15.67	15.33	14.00	0.1023
Gas volume	18.67^{b}	20.00^{ab}	26.33^{a}	24.67^{ab}	0.0569
Digestibility (%)	51.70^{c}	47.60^{d}	58.33^{b}	61.41^{a}	<0.0001
Metabolisable Energy (MJ/kg)	7.20^{d}	7.34^{b}	8.48^{a}	8.23^{a}	<0.0001
Organic Matter Digestibility (%)	48.32^{d}	51.48^{c}	55.57^{b}	57.43^{a}	<0.0001

Means with different superscripts are significantly different ($p<0.05$)

However, the Neutral Detergent Fiber fell within the minimum and maximum range of 54.1- 79.9% reported by (Egbunogie and Bamikole *et al*., 2014). Acid Detergent Lignin (ADL) was lower than 35% reported by (Ogunjobi *et al*., 2014) and does not differ from the values range of 27-59% reported by (Egbunogie and Bamikole *et al*., 2014). The cellulose content (CC) values in this study were lower than 45.60% reported by (Tangenjaja *et al*., 2008). The hemicellulose content (HC) was similar to value of 20.78% reported by (Ogunjobi *et al*., 2014). The increase in *in-vitro* dry matter digestibility and *in-vitro* organic matter digestibility with increasing protein levels indicates the potential of improving feed efficiency of low-quality forages (Bargo *et al*., 2003). Cellulolytic activity is highly dependent on the type and amount of substrate in the form of fibre. If the fibre content of the feed is high, the level of cellulase enzyme activity will increase, and conversely. The high cellulolytic activity is caused by the ability of microbes to digest cellulose quickly (Qori'ah *et al*., 2016). The differences in the nutrient contents and *in-vitro* digestibility parameters might be attributed to the effect of molasses on the process of ensiling the grasses.

CONCLUSION

It could be concluded that inclusion of graded levels of molasses as additives in elephant grass silage led to higher nutrient contents, increased in-vitro gas production as well in-vitro dry matter digestibility and reduced fibre fraction of silage

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