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Nutritive Value of Napier Grass Ensiled Using Molasses as an Additive

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----------ABSTRACT----------

The study sought to determine the quality of ensiled elephant grass using molasses as a n additive. Elephant grass was obtained on the 8th week of regrowth, chopped to an average particle length of 4-8cm and filled into plastic containers. The cut elephant grass was allotted to a completely randomized and repeated measures design with 3 replicates per treatment, consisting of elephant grass without molasses (T0), elephant grass with 50ml molasses (T1), elephant grass with 100ml molasses (T2) and elephant grass with 150ml (T3). Three (3) samples of each treatment were opened at the end of the fermentation period (30, 60, 90 days) for the determination of pH, CP, DM, Ash, NDF, and ADF. The addition of molasses at 150ml was found to promote DM, NDF, and ADF. The pH decreased with levels of additive over time during the ensiling process. However, silage with no additives showed the highest pH indicating poor quality silage. There was no significant difference between 30 and 60 days, but there was a significant difference in the 90 days of ensiling. Both ADF% and NDF% remain unchanged, but there some level of significance for 90 days as compared with both 30 and 60 days, which show no significant difference in ADF. While throughout the fermentation periods, there was no significant difference across the days. It was concluded that 150ml of additive ensiled for 90 days make quality elephant grass silage.

Keywords: *Elephant grass, additives, molasses, pH,*

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I. INTRODUCTION

Growing human population urges the tremendous need to exploit the existing livestock resources to meet the animal protein requirement. Therefore, optimal fodder and forage production must be ensured. Owing to the seasonal scarcity of feed for livestock particularly in Ghana, that has a long dry season, forage and fodder should be stored for all year round for feeding. One way to improve the current situation is the introduction of high yielding fodder varieties and adopting a technology through which fodder can be conserved for feeding during the long dry periods. At the same time, to harvest maximum nutrients beneficial for livestock feeding, fodder cuts at the proper stage are very imperative as crude protein contents decreased and fibre contents increased with the fodder maturity (Lee, Buu et al. 1991).

Excess forages can be conserved as hay or silage. Forages can be made into hays to preservenutrients, especially protein before they decline in the plant. However, it is often too wet to dry successfully, andspecialized machinery has to be used to assist forage to dry quickly. Forage crops such as maize, are too thick-stemmed to dry successfully as hay.

Silage is a method of enhancing forage longevity through creating an optimal fermentation process by reducing the pH within minimum fermentation period. The inadequate amount of oxygen and the accumulation of lactic acid inhibit its microbial metabolism and preserve nutrients (McDonald, EDwards et al. 1995, Ranjit and Kung 2000). Furthermore, the achievement of an excellent fermentation process to a large extent depends on anaerobic and low pH conditions.

The low pH is usually accomplished throughthe fermentation of sugars in the crop to lactic acid bylactic acid bacteria, which decreases plant enzymeactivity and prevents the proliferation of detrimentalanaerobic microorganisms, especially clostridia andenterobacteria (Yang, Huang et al. 2004).

Silage is considered the best way to conserve forage crops. A forage crop can be cut early and only

must have 30% dry matter to be ensiled successfully (O. 1999). Therefore, there is no need to dry out the plant material beyond the estimated percentage. Also, silage is primarily of importance in areas where weather patterns do not allow easy drying of forages for making good hay (Saun 2000). Silage can bekeptforupto3yearswithoutdeteriorating.Silageisverypalatabletolivestockandcanbe fed at any time.

(McDonald, Henderson et al. 1991)classified silage additives into two main groups, namely, stimulant (which comprises of sugars, lactic acid bacteria, and enzymes) and the inhibitors (consisting of formic acid, sulphuric acid, and formaldehyde). The stimulant according to (McDonald, Henderson et al. 1991) enhances the desired lactic acid fermentation while the inhibitors sterilize or acidify silage by preventing the growth of undesirable microorganisms. In practice, molasses is widely used as an additive to enhance the process of ensiling(Yakota, Kim et al. 1992, Yunus, Ohba et al. 2000, Van Niekerk, Hassen et al. 2007, Bilal 2009) because of its high content of water-soluble carbohydrate of elephant grass. Using molasses or corn additive can increase the amount of fermentation end products due to the fermentation of the available sugars (Yokota, Fujii et al. 1998).

Elephant grass (*Pennisetum purpureum Scheum*) is one of the popular grasses in the tropics and subtropics and is usually harvested at short intervals to feed at an early growth stage because the nutritive values of the grassare influenced by harvesting interval (Woodard and Prine 1991). (Yokota H. 1991) reported that Elephant grass ensiled with molasses could be stored in good condition even if the silages were stored in high ambient temperature.

Therefore, this study sought to determine the quality of ensiled elephant grass using molasses as additive over time.

II. MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Department of Animal Science Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi Ghana.

Experimental Materials

The materials used for the experiment were eight (8) weeks regrowth of elephant grass, molasses, plastic bucket (10L plastic bucket), and plastic sheet. The Elephant grass was obtained from the Department of Animal Science while the molasses was also obtained from the sugarcane refinery company at Takoradi. The plastic bucket and the plastic sheet were also obtained from the Kumasi central market.

Experimental Procedure

The eight (8) week regrowth of elephant grass was chopped into approximately 4-8cm length pieces using a cutlass and a wooden chopping board. The cut grass was mixed thoroughly and wilted for nearly three hours. Sugarcane molasses was mixed with the cut grass at the time of filling and the materials were packed into a 10Lplastic bucket

Experimental Treatment And Design

Three treatments which comprised of Elephant grass with no preservatives (T0) Elephant grass with 50mL of molasses and 100mL of water (*T1*), Elephant grass with 100mL of molasses and 200mL of water (*T2*) and Elephant grass with 150mL of molasses and 300mL of water(*T3*). A complete randomized block design with three replicates pretreatment and four sampling periods (0, 30, 60, and 90days) as the repeated measure was used.

Chemical Analysis

Samples were analyzed for dry matter, crude protein, ADF, NDF and ash according to the (AOAC 2000). Samples were appraised for colour, texture, smell, temperature, and pH. The colours for the silage were obtained using a colour chart.

Statistical Analysis

TheparametersmeasuredwereanalyzedusingGenStat12thedition with repeated measures. Terms in the model were additive levels (i.e., control, T1, T2, T3), days of sampling (i.e., 0, 30, 60 and90). The repeated term was sampling days, with elephant grass within molasses used as an additive.

III. RESULTS AND DISCUSSION

Sensory Appraisal

The colour, smell, and texture in (Table 1) below show the sensory appraisal of the ensiled elephant grass. Similartexturewas observed among the treatments, which indicates a good silage according to (Kaiser and Weiss 1997). The molasses treated grass had a colourranged from green to light brown, which is an indication of good silage (Kaiser and Weiss 1997). In the first 30 days, *T0* had greenish colour while *T1, T2, T3* had light brown colour. In the 2nd month, *T0* had light green colour while all the treatment *T1, T2, T3* had a light brown colour. The *T0, T1, T2, and T3* all had the same colour light brown at the end of the 90 days study. The smell

obtained throughout the experiment was mild for the first 30 days, 60 and 90 days presented an ethanol-like smell which would enhance fodder acceptability of livestock when fed with it.

Table 1: Silage characteristics of elephant grass after 90 days of ensilage

	Treatments	Colour	Smell	Texture	pH
0	T0	Greenish	Mild	Firm	4.59
	T1	Greenish	Mild	Firm	5.45
	T2	Greenish	Mild	Firm	5.67
	T3	Greenish	Mild	Firm	5.74
30	T0	Greenish	Mild	Firm	4.71
	T1	Light brown	Mild	Firm	4.96
	T2	Light Brown	Mild	Firm	4.72
	T3	Light Brown	Mild	Firm	4.65
60	T0	Light Green	Ethanol	Firm	4.53
	T1	Light Brown	Ethanol	Firm	4.38
	T2	Light brown	Ethanol	Firm	4.21
	T3	Light Brown	Ethanol	Firm	4.27
90	T0	Light brown	Ethanol	Firm	4.30
	T1	Light brown	Ethanol	Firm	3.98
	T2	Light brown	Ethanol	Firm	3.96
	T3	Light brown	Ethanol	Firm	3.68

pH

The changes in pH of the elephant grass silage were due to the additives and ensiling as shown in (Figure 1). Maximum pH was found in treatment 3, and it decreased with an increase in the fermentation period. However, a decrease in pH due to levels of additives and fermentation period was observed. However, a minimum value was found at 90 days fermentation period that differed significantly ($P<0.05$) with 30 and 60 days of fermentation periods. Both 30- and 60-days fermentation periods were significantly different. The means of control T0 were significantly different T1, T2, and T3. However, there were no significant differences between the means of T1, T2, and T3. According to (McDonald 1991, Yang, Huang et al. 2004), attainment of low pH is one of the critical determinants for final silage fermentation quality.

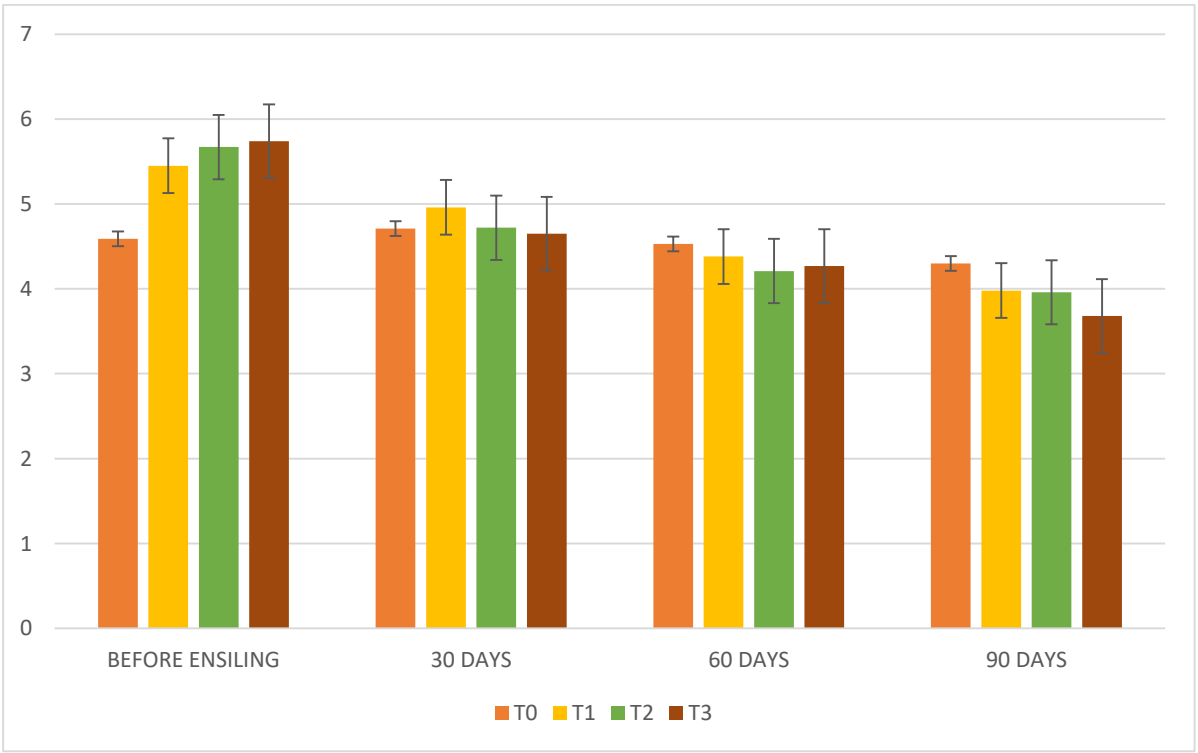

Figure 1: Graphical presentation of pH of elephant grass before and after ensilage

CHEMICAL COMPOSITION OF SILAGE

Table 2: Nutrient Composition of Elephant grass before ensiling

Parameter	**Napier grass**
Drymatter %	**49**
Crude protein	**9.68**
Ash	**13.8**
NDF	**73.97**
ADF	**45.65**

Table 3: NUTRITIVE VALUE OF ELEPHANT GRASS AFTER 30, 60, AND 90 DAYS OF ENSILAGE

Parameter	Days(D)	Treatment (T)					Factor	Lsd	P-value
		T0	T1	T2	T3	Mean			
Dry matter	30	39.65	40.77	42.24	41.24	40.98^{b}	T	2.906	0.590
	60	27.99	26.15	26.04	28.55	27.19^{a}	D	2.517	<.001
	90	24.02	22.73	27.01	23.55	24.33^{a}	D		
	Mean	**30.56^{a}**	**29.89^{a}**	**31.76^{a}**	**31.11^{a}**		**T*D**	**5.033**	**0.625**
CP	30	6.21	5.70	6.15	6.36	6.10^{a}	T	0.390	0.028
	60	6.57	5.86	5.63	6.35	6.10^{a}	D	0.338	<.001
	90	6.25	7.52	6.74	7.61	7.03^{b}			
	Mean	**6.34^{ab}**	**6.36^{ab}**	**6.17^{a}**	**6.77^{b}**		**T*D**	**0.676**	**0.003**
Ash	30	8.83	7.83	7.83	5.50	7.50^{c}	T	0.469	<.001
	60	6.99	6.00	6.17	7.51	6.67^{b}	D	0.406	<.001
	90	5.83	6.17	5.67	5.33	5.75^{a}			
	Mean	**7.22^{a}**	**6.67^{ab}**	**6.56^{a}**	**6.12^{a}**		**T*D**	**0.813**	**<.001**
pH	30	4.71	4.96	4.72	4.65	4.76^{c}	T	0.369	<.001
	60	4.53	4.38	4.21	4.27	4.35^{b}	D	0.317	<.001
	90	4.30	3.98	3.96	3.68	3.98^{a}			
	Mean	**4.51^{b}**	**4.44^{a}**	**4.30^{a}**	**4.2^{a}**		**T*D**	**0.639**	**0.788**
ADF	30	49.15	45.84	45.84	46.49	46.83^{b}	T	2.715	0.318
	60	45.83	47.11	47.80	44.49	46.31^{b}	D	2.352	<.001
	90	41.87	39.80	38.67	38.33	39.67^{a}			
	Mean	**45.62^{a}**	**44.25^{a}**	**44.10^{a}**	**43.11^{a}**		**T*D**	**4.703**	**0.600**

NDF	30	69.40	67.33	66.47	67.20	67.60^{a}	T	3.329	0.017
	60	69.93	71.07	68.53	65.13	68.67^{a}	D	2.883	0.702
	90	73.00	68.47	69.60	63.20	68.57^{a}			
	Mean	**70.78^{b}**	**68.96^{ab}**	**68.20^{ab}**	**65.18^{a}**		**T*D**	**5.766**	**0.401**

^{ab}means with the same superscripts are not significantly different (P>0.05) from each other while means with different superscripts are different (P<0.05). Lsd=least significant difference.

The DM recovery was higher due to additives (Bilal 2009) compared to control (Table 3). More DM recovery with molasses may be due to the addition of water-soluble carbohydrates that improves the fermentation characteristics. Once the fermentation becomes stable at very low pH, DM production reduces. (Sharp, Hooper et al. 1994, Weinberg and Muck 1996)Have indicated that increased DM recovery may be due to homo-lactic fermentation, which decreased fermentation losses. Lactic acid production reduces the carbon loss which results in more DM recovery.

The CP contents of all the treatments were similar (P>0.05) among the 30 and 60 days. The rise in CP of molasses treated silage could be due to the addition of additives when compared with control (Table 3). Maximum CP was found at Treatment 3 that differed significantly from other levels. The possible reason forincrease in CP during ensiling may be the fact that proteolytic activity during fermentation produces NH_3, but due to efficient fermentation and early stability of silage, this proteolysis activity is inhibited, and the produced NH_3 helps in getting the aerobic stability because of its fungicidal properties (Kung, Robinson et al. 2000). The CP values recorded with increasing ensiling time confirms the study by (Snijders and Wouters 2004, Van Man and Wiktorsson 2006) and this was attributed to increasing levels of molasses (Snijders and Wouters 2004).

The Ash contents among the control, T2 and T3 were not significantly different (P>0.05) from each other. More Ash contents at 30 days compared to 60- and 90-days ensiling. There was a significant difference (P<0.05) in ash between 30, 60 and 90 days of ensiling. Moreover, T0 was 1.08 higher than T1 comparing it to T2 and T3 which was 1.00 and 1.18 respectively higher. Various previous studies (Garcia, Olson et al. 1989, Mustafa, Christensen et al. 2000) supported these findings and reported that ash contents increased to some extent during ensiling at different fermentation periods. This increase may be attributed to increasing in DM during ensiling and reduction in control may be due to DM loss.

The ADF and NDF decreased with increase in molasses levels because molasses has little ADF and NDF content, these results were inconsistent with (Nayigihugu, Kellogg et al. 1995). Addition of molasses improves fermentation, and in silos in which only molasses was administered, it affected the ADF (Balakhial, Naserian et al. 2008). There was no significant difference (P>0.05) among the means of various treatment for ADF. There was no significant difference (P>0.05) between 30 and 60 days but 90 days was significantly different (P<0.05) from them. The NDF appears not to be significantly different from each other across the days, but with levels of molasses inclusion, T1 and T2 were not significantly different (P>0.05) whereas T0 and T3 were significantly different (P<0.05).

Molasses in silages is mostly added as a sugar additive to increase fermentation and feeding quality of the silage (Yunus, Ohba et al. 2000). The addition of molasses on clover grass silage was found to produce more lactate and less acetate and ammonia-N than the untreated control (McDonald 1991). Yokota et al. 1992 stated that the addition of 4% molasses as sugar additive in wilted Napier grass silage reduced the pH value from 4.72 to 3.99 and the fermentation type was acetate but abundance of lactate.

IV. CONCLUSION

The result concluded that the addition of molasses improved the quality of elephant grass silage regarding physical properties and chemical composition. Elephant grass ensiled for 90 days with 150mL of molasses (T3) appears to produce quality silage since it lowers the pH, ADF, NDF, and giving a high CP value.

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