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EFFECTS OF ENSILING *DAB* GRASS (*DESMOSTACHYA BIPINNATA*) WITH MAIZE AND DIFFERENT MOLASSES COMBINATIONS ON PROXIMATE COMPOSITION AND DIGESTIBILITY IN GOATS

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ABSTRACT

The study aims to determine the effects of preserving *Dab* grass (*Desmostachya bipinnata*) by mixing it with maize as silage, and its digestibility in small ruminants so that the low palatable grass can be utilized. Dab grass mixed with maize (ratio 1:3) was ensiled without molasses (control), or with 2, 4, and 6% molasses. The physical and nutritional properties of the prepared silage were determined. Twelve goats of *Beetle* breed (9 -12 months age, 35 - 40 kg body weight) were randomly divided into four groups and fed on the silage treatments. The 6% molasses treatment resulted in better ($P<$ 0.05) physical and nutritional properties of the silage. The silage with 4% molasses had higher ($P<$ 0.05) digestibility of organic matter and crude protein, while the silage with 6% molasses had higher ($P<$ 0.05) digestibility of fiber and its fractions, compared with other treatments. The levels of lead in silage increased with increasing levels of molasses up to 53 mg/kg in the 6% molasses treatment. These results indicated that addition of molasses improved the physical and nutritional properties of silage made from maize and less palatable *Dab* grass. It is therefore concluded that addition of a maximum of 4% molasses may be recommended, beyond which heavy metal toxicity may occur.

Key words: *Desmostachya bipinnata*, maize, silage, digestibility.

INTRODUCTION

Animal production in Pakistan has been affected by decline in area under fodder production, due to low per acre fodder yield and two fodder scarcity periods in May to June, and from November to December every year (Sarwar *et al*., 2002). Except for the scarcity periods, fodder availability is better in the irrigated areas. In rain fed areas, like Potohar region, more than 70% of the annual precipitation occurs in the monsoon during July-September. In these areas, range grasses are sufficiently available just after the onset of the monsoon. *Desmostachya bipinnata* (*Dab* grass) is a low palatable grass that is low in digestible nutrients but is abundantly available throughout the year. *Dab* grass can be used as fodder substitute owing to the reasonable crude protein content of 6-7% in the leaves (Fakhireha *et al.*, 2010). Incorporation of this grass with existing feed sources may bridge the gap between supply and demand during scarcity periods.

Maize fodder has been used more commonly as a silage crop in both temperate and tropical climates due to its high soluble carbohydrate fractions (Phipps, 1996). Addition of molasses and ensiling of maize with *dab* grass can be an effective way of proper utilization of the low palatable *Dab* grass. Molasses are appropriate for feeding ruminants as it is appetizing and manageable to utilize. It also stimulates fermentation due to its high fermentable carbohydrate contents. It accelerates the natural silage preservation by dropping the pH and supporting lactic acid bacteria. Previously, Sibanda (1986) also reported that molasses promote the intake of less palatable feeds by masking taste and odor. Therefore, the present study was undertaken to investigate the effects of addition of molasses on quality and digestibility of the *Dab* grass and maize silage.

MATERIALS AND METHODS

The study was conducted in the field area of National Agriculture Centre (NARC), Islamabad, located at 33.43 °N 73.04 °E at the edge of the Potohar Plateau. Climate is humid subtropical with hot, humid summers accompanied by a monsoon season followed by cool winters. The soils of the area are non-saline and non-sodic, have a slightly alkaline pH and are low in organic matter.

Ensiling: Maize and *Dab* grass were collected from the field and range area, respectively, of the National Agricultural Research Centre (NARC), Islamabad. Sugarcane molasses was purchased from the local market. Silage was prepared by mixing low palatable grass *Dab* with maize fodder at dough stage. *Dab* and maize were chopped to approximately 2.5 cm length and mixed in a ratio of 1:3. Maize and *dab* grass was ensiled without molasses (control), or with the addition of 2, 4, or 6% molasses. In all cases, material was ensiled in large plastic drums lined with polythene sheet and then compressed through manual trampling. Drums were sealed airtight using a lid to maintain strict anaerobic conditions and was kept at room temperature for 60 days. Samples were taken from center of the ensiled mass of each drum for analyzing pH, proximate composition, fibre fractions, and physical variables as mentioned in the section on chemical and statistical analyses.

Digestibility Trial: Twelve goats of *Beetle* breed with an average body weight of 35- 40 kg (9 -12 months age) were randomly assigned to each of the silage prepared with 3 animals per treatment. Deworming and required vaccination of the animals was done before the experiment. Animals were housed in digestibility pens, and were given an adjustment phase of 10 days during which the experimental silage treatment were offered *ad libitum.* Fresh water was offered twice a day. For the next 5 days, the animals were offered weighed silage every morning at the rate of 90% of the *ad libitum* intake. Feces were collected for 5 days, and samples of feed and feces voided were collected in air tight containers. Samples were kept at -20 °C until analysis.

Chemical and statistical analyses: The feed and fecal samples were dried at 60 °C and processed for the determination of proximate and fibre composition following AOAC (1990). The pH of each sample was determined in triplicate using digital pH meter (Orion 420 A+; Thermo Electron Corporation). The fat (EE) and fibre (CF) determinations were carried out on a fat extractor (Ankom XT151 Extractor, Macedon, NY) and a fibre analyzer (Ankom A2000I Fiber Analyzer, Ankom, Macedon, NY), respectively using standardized protocols. For crude protein (CP) estimation, the samples were digested on an auto Kjeldhal system (Digest System K-437, and Auto Kjeldahl Unit K-370; Büchi), while distillation and titration were performed manually using conventional Markham still and burette. Nitrogen recovery in this procedure was 102% and this was determined using urea and glycine as standards. Results were not corrected for nitrogen recovery. Results on crude fibre and fat were compared with previously known lab standards. Bacterial counts were determined using standard microbiological techniques (Benson, 2002). Heavy metals concentrations were determined using atomic absorption spectroscopy with graphite furnace (AAnalyser 800, PerkinElmer; Waltham, MA).

Data for the fermentation, chemical composition, and digestibility studies of the silage were subjected to ANOVA for analysis of variance technique under completely randomized design by using Statistix 8.1 (Analytical software, 2005).

RESULTS AND DISCUSSION

Fermentation characteristics of silage due to molasses addition: The changes in the physical characteristics and pH of *Dab* and maize silage due to molasses addition are given in Table 1. The silage with addition of molasses had better aroma, color, and softness as compared to the silage without molasses treatment. Also, the pH values of silage decreased (P< 0.05) with increase in the amount of molasses. Previous authors have also reported similar effects of molasses addition on pH (Yunus *et al*., 2000) and physical characteristics (Islam *et al.*, 2001) of silage. Maximum nutrient preservation in silage is dependent on how rapidly the fermentation is attained. Kung (2000) in this regard reported that prompt reduction in pH obstructs the growth of undesirable anaerobic microorganisms i.e. enterobacteria and clostridia. The currently reported bacterial counts also show better aerobic stability of the silage which ultimately could be the reason of the desired silage pH.

Chemical composition of Dab grass and maize silage: Effects of molasses addition on the proximate composition and fiber fractions of the silage are presented in Table 2. Dry matter DM, and ash contents increased (P< 0.05), whereas CF (Crude Fibre), NDF (Neutral Detergent Fibre) and ADF (Acid Detergent Fibre) contents decreased (P < 0.05) with increase in molasses contents of the silage. No effect was observed on crude protein level with increasing levels of molasses.

The addition of molasses at 2, 4, and 6% levels increased the DM content of silage by 13.4, 16.7, and 14.2%, respectively. Present results on DM content of the silage without molasses addition are in accordance with those reported previously for maize silage (Donmez *et al*., 2003; Aksu *et al*., 2004). Increased DM content at higher levels of molasses has been reported by Yunus *et al.* 2000. Whereas, Man and Wiktorsson (2001) also noted DM content of maize silage increased from 26.5 to 28.1% with 4% molasses addition. This improvement could be due to protection from spoilage owing to higher acetic and butyric acid production.

In the present study, the molasses addition at 6% level improved the ash content of the silage by 33% over the control. These findings are supported by studies reported by (Mustafa *et al*., 2000). Addition of molasses results in higher ash levels because molasses itself has high mineral contents which ultimately increase ash content (Gofeen and Khalifa, 2007). The higher heavy metal content of the silage with molasses addition supports this notion. The increase in DM of the molasses treated silage could contribute to higher ash values as well.

The crude fibre, NDF, and ADF contents decreased with increase in molasses content of the silage. These results agree with Fazaeli *et al*. (2003), and Guney *et al*. (2007) who reported decrease in fiber contents of liquid whey treated straw silage, and for molasses treated sorghum silage, respectively. Likewise, Yunus *et al.* (2000) reported that addition of molasses and urea+molasses to elephant grass results in lower NDF and ADF content of silage. Kung *et al.* (2000) and Nadeau *et al.* (2000) have attributed the decline in fiber contents of silage to microbial proteolytic, and fibrolytic activities. The addition of molasses in this connection is known to enhance fermentation which subsequently increases cell wall degradation (Baytok *et al.*, 2005).

Molasses is known to be high in heavy metal content (Nicholson *et al*., 1999; Liu *et al*., 2008). Therefore, the purpose of analyzing the heavy metal concentration in this study was to determine if molasses addition was resulting in higher levels of any toxic metal in the silage. The addition of molasses resulted in higher ($P< 0.05$) levels of the nickel (Ni), cadmium (Cd), and lead (Pb) in the 6% molasses treated silage. The levels of Pb particularly exceeded the tolerable limit of 30 mg/kg (NRC, 1980), showing that silage with 6% molasses may result in lead toxicity if used for long term feeding.

Digestibility of the silages: Data regarding the digestibility of the silages are presented in Table 3. The trend of increase in macronutrients with increase in molasses concentration was not seen in case of digestibility. The OM and CP digestibility was higher ($P< 0.05$) under the 4% molasses treatment compared with the control and 2% molasses treatment. These improvements in digestibility with addition of molasses up to 4% level may be due to higher nutrient contents in the silage which in turn improves intake and growth rates in ruminants (Mustafa *et al*., 2008). Beyond the 4% molasses level, no improvements in digestibility of CP and OM were found. This could be due to less retention time of digesta in the gastrointestinal tract of animals under 6% molasses silage, as evident by loose feces of these animals. The ADF and NDF digestibility of the 6% molasses silage was higher ($P< 0.05$) as compared to the control and other treatments. These improvements in fibre digestibility could be due to higher microbial enzymatic activities with molasses addition as mentioned earlier.

Present results indicate that maize silage can be supplemented with *dab* grass and addition of molasses in silage improves the physical and nutritional properties and preservation capacity of silage. Addition of molasses resulted in good color, odor, softness, nutritional quality, palatability and digestibility in goats. With the present results in view, it is recommend that 4% molasses inclusion is safe for animals keeping in view of heavy metal toxicity. Long term feeding studies are however needed in this direction.

Table 1. Physical characteristics and pH of *Dab* and maize silage.

Item	Control	2% Molasses	4% Molasses	6% Molasses
Color	Brownish green	Dark brown	Light brown	Olive green
Smell	Moderately good	Moderately good	Pleasantly acidic	Sour
pH	4.64 ± 0.03^{a}	4.34 ± 0.05^{ab}	4.06 ± 0.01^{bc}	3.80 ± 0.06^{c}
Bacterial counts[1]	6.33×10^{3}	3.49×10^{4}	2.64×10^{4}	2.12×10^{4}
Texture	Hard	Hard	Moderately soft	Moderately soft

Means with different superscripts in a row differ significantly at $P < 0.05$; SEM = standard error of the mean.
[1] Aerobic bacteria grown using MRS agar.

Table 2.Chemical analyses of mixed silage.

Item	Control	2% Molasses	4% Molasses	6% Molasses	SEM
Nutrients (g/100g):					
DM	23.9^{c}	27.1^{b}	27.9^{a}	27.3^{b}	0.14
CP	7.8	7.7	7.4	7.0	0.16
EE	4.9^{b}	5.8^{a}	4.5^{b}	4.8^{b}	0.20
Ash	8.0^{b}	8.3^{b}	9.0^{b}	10.7^{a}	0.47
CF	30.4^{a}	27.3^{b}	25.5^{c}	23.9^{d}	0.30
NDF	65.7^{a}	58.2^{b}	60.9^{b}	49.2^{c}	0.96
ADF	39.2^{a}	34.3^{b}	32.3^{b}	27.6^{c}	0.81
Heavy metals (mg/kg):					
Ni	3.0^{b}	5.0^{b}	4.2^{b}	9.8^{a}	0.20
Cr	5.6	5.8	2.8	5.2	0.47
Cd	1.2^{b}	1.2^{b}	2.2^{b}	3.0^{a}	0.03
Pb	2.6^{c}	7.6^{bc}	28.0^{b}	53.4^{a}	0.69

Means in a row with different superscripts differ significantly at $P \leq 0.05$; SEM = standard error of the mean.
Maximum tolerable limits (mg/kg): Ni = 50, Cd =5, Pb = 50, Cr = 1000 (NRC, 1980, 1997).

Table 3. Digestibility (%) of the silage nutrients in growing goats.

Item	Treatments				SEM
	Control	2% Molasses	4% Molasses	6% Molasses	
OM digestibility	46.1[b]	48.1[b]	51.5[a]	49.2[ab]	5.3
CP digestibility	49.9[b]	52.0[b]	59.0[a]	55.4[ab]	3.3
ADF digestibility	51.5[b]	53.7[ab]	55.9[ab]	60.8[a]	3.1
NDF digestibility	57.8[c]	62.8[bc]	67.3[ab]	73.0[a]	3.7

Means in a row with different superscripts differ significantly at $P \leq 0.05$; SEM = standard error of the mean.
OM = organic matter, CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.

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