EFFECT OF MOLASSES AND CORN AS SILAGE ADDITIVES ON CELL WALL FRACTIONS OF MOTT GRASS SILAGE WITH DIFFERENT FERMENTATION PERIODS

Bilal, M. Q.

Department of Livestock Management, University of Agriculture, Faisalabad 38040-Pakistan;
Corresponding author: livestockmanagement2005@hotmail.com

ABSTRACT

The aim of the present study was to determine the impact of silage additives on fiber fractions of mott grass silage at varying fermentation periods. For this purpose, mott grass was cut at two stages of maturity (45 and 60 days) from the field of Livestock Experiment Station, University of Agriculture Faisalabad. The cane molasses and crushed corn was used @ 0, 1, 3 and 5 % of the fodder (dry matter) along with three fermentation periods (30, 35 and 40 days). Study results indicated that there was a significant decrease ($P < 0.05$) in neutral detergent fiber (NDF), acid detergent fiber (ADF) and cellulose contents due to additives and fermentation periods. However, an increasing trend in cell wall contents was observed where no additive was added. On over all basis, NDF, ADF and cellulose contents decreased from 72.69-71.47; 43.06-43.70 and 39.86-39.23%, respectively due to increase in additive level from 0-5% but the decrease in NDF and ADF contents was 72.28-71.59 and 42.57-41.97% due to fermentation period. The effect of fermentation period on cellulose contents was non-significant. The addition of molasses @ 3% was found optimum to reduce cell wall fractions at 35days fermentation period.

Key Words: Cell wall fractions; Corn; Fermentation periods; Mott grass; Molasses; Silage.

INTRODUCTION

Forages are the cheapest source of livestock feeding the world over. In developing countries like Pakistan, low per acre fodder yield and limited area under fodder cultivation are the major constraints in economics livestock production. There are two fodder scarcity periods (Nov-Jan and May–Jul) in Pakistan, resulting a negative impact on livestock production (Bilal, 1998). Preservation of fodder as hay and silage are the alternatives for continuous fodder supply to livestock round the year. The other way to improve the current situation is the introduction of high yielding forage varieties such as mott grass. It is high quality forage that maintains its quality over long re-growth intervals and has the potential to provide fodder in one slump period (May-Jul) If mott grass is preserved as silage during this period and fed during second slump period (Nov-Jan), regular fodder supply can be ensured. Due to its high dry matter production under good soil fertility and proper management, it is frequently used in cut and carry systems. Silage seems to be the most suitable alternative to preserve it, as haymaking due to the great stem proportion impairs adequate moisture reduction. However, low dry matter contents and reduced amounts of water soluble carbohydrate (WSC), together with a high buffering capacity, are considered limiting factors to a successful fermentation when ensiling. Adding WSC sources such as molasses (Yokota *et al*., 1991), glucose (Tamada *et al*., 1999), and cassava meal (Panditharatne *et al*., 1986) to fresh mott grass at ensiling has resulted in increased lactic acid production. Successful silage fermentation depends on achieving both anaerobic conditions and a low pH. The low pH, is usually accomplished through the fermentation of sugars in the crop to lactic acid by lactic acid bacteria, decreases plant enzyme activity and prevents the proliferation of detrimental microorganisms, especially clostridia and enterobacteria (Woolford, 1984). The type of additive used can also influence the amount of fermentation end products. Use of molasses as an additive, increases the amount of fermentation end products due to the fermentation of the available sugars (Abou- Roya *et al*., 1973). Molasses enriches the fresh material with carbohydrates and fills the gaseous pores, thereby reducing the influx of oxygen in the silage (Lattemae *et al*., 1996). Corn is rich in non-fiber carbohydrates and is an alternative source to provide fermentable carbohydrates for silage fermentation (Kung *et al*, 2000). The present study was conducted with an aim to evaluate the molasses and corn as additives and their consequent effect on cell wall fractions of mott grass silage.

MATERIALS AND METHODS

Mott grass was obtained at 45 and 60 days of its re-growth from the field adjacent to Livestock Experiment Station, University of Agriculture, Faisalabad. The mott grass was chopped with an average particle length of ½ inches and thoroughly filled in plastic

boxes by mixing two additives (molasses, corn), @ 0, 1, 3 and 5 % of forage DM, with three replicates each. In this way 72 silos for each stage of cut were prepared and kept at room temperature. Three silos of each treatment were opened at each fermentation period for each stage of cut for determination of neutral detergent fiber (NDF), acid detergent fiber (ADF) and Cellulose by using the methods as described by Van Soest *et al*., (1991).

Statistical analysis: The data on each parameter was analyzed according to Completely Randomized Design with four factors and three replicates. The means were compared using Least Significance Difference test (Steel *et al*., 1997). A COSTAT computer package (CoHort Software, Berkeley CA, USA) was used for analysis of variance of data for all parameters.

RESULTS AND DISCUSSION

The change in NDF contents of mott grass silage has been presented in Table 1. Statistical analysis indicated that NDF contents of mott grass silage decreased significantly (P <0.05) due to type of additives, level of additives and fermentation periods, but 3 % level of additive did not differ significantly from 5 % level (Table 2).

The ADF contents of mott grass silage as influenced by stage of cut, type of additive, level of additives and fermentation periods has been mentioned in Table 3. Analysis of the data indicated a significant (P <0.05) difference in ADF contents by increased level of additives and type of additive. However, there was non-significant difference in ADF values at 35 and 40 days fermentation periods (Table 4). Almost a similar trend was found in case of cellulose contents of mott grass silage except there was non-significant difference between varying fermentation periods, type of additive and 3 and 5 % level of additive (Table 5 & 6).

The results of the present study are in line with those of Kung *et al.,* (2000); Nelson and Satter (1992), Shepherd and Kung (1996) who reported that there must be some decrease in cell wall fractions due to the partial acid hydrolysis of hemicellulose and the entire fiber fractions. Additives reduced the NH_3-N contents and subsequently the fibrous fraction of the silage (Rooke *et al*., 1988; Gordon 1989). Similar findings were reported by Coblentz *et al*., (1998) and Johnson *et al*., (1999). Various previous studies (Acosta *et al*., 1991; De Boever *et al*., 1993) also indicated that there was effect of

Table 1: Neutral detergent fiber (%age) of mott grass silage as affected by level of additives and fermentation period

Additives	Levels	45 days stage of cut Fermentation periods			60 days stage of cut Fermentation periods		
Molasses		30	35	40	30	35	40
	0 %	69.98±0.018	70.33±0.338	69.95±0.026	75.00±0.006	75.10±0.022	75.16±0.0015
	1 %	69.90±0.022	69.75±0.026	69.70±0.006	74.90±0.022	74.45±0.026	74.31±0.026
	3 %	70.10±0.022	70.02±0.032	69.98±0.018	74.41±0.026	74.00±0.006	70.20±0.023
	5 %	69.95±0.026	69.80±0.022	69.53±0.026	73.95±0.026	73.90±0.022	73.80±0.023
Corn	0 %	70.33±0.335	70.15±0.026	70.20±0.023	75.02±0.032	74.90±0.015	74.98±0.022
	1 %	69.85±0.026	69.90±0.027	69.00±0.006	75.00±0.006	74.65±0.026	74.36±0.021
	3 %	69.80±0.018	68.42±0.192	68.80±0.018	74.87±0.015	73.68±0.020	73.40±0.023
	5 %	68.93±0.023	68.01±0.003	68.35±0.026	74.53±0.021	74.28±0.020	73.83±0.021

Table 2: Mean comparison of Neutral detergent fiber of mott grass silage

Stage of cut	*Mean* (%)
45 days	69.71[b]
60 days	74.27[a]
Additives	
Molasses	72.00[b]
Corn	73.88[a]
Level of additives	
0 %	72.59[a]
1 %	72.14[b]
3 %	71.50[c]
5 %	71.47[c]
Fermentation periods	
30 days	72.28[a]
35 days	71.95[b]
40 days	71.59[c]

Values with different superscripts differ significantly (P <0.05)

Table 3: Acid detergent fiber (%age) of mott grass silage as affected by level of additives and fermentation period

Additives	Levels	45 days stage of cut Fermentation periods			60 days stage of cut Fermentation periods		
Molasses		**30**	**35**	**40**	**30**	**35**	**40**
	0 %	39.70±0.022	39.75±0.026	39.90±0.023	46.20±0.023	46.25±0.021	46.75±0.021
	1 %	39.65±0.021	38.43±0.021	38.15±0.012	46.10±0.023	45.40±0.023	45.10±0.026
	3 %	38.65±0.026	37.28±0.022	37.90±0.027	45.73±0.021	45.90±0.015	45.48±0.107
	5 %	38.85±0.021	37.10±0.023	37.80±0.027	45.80±0.015	44.85±0.021	44.70±0.017
Corn	0 %	39.35±0.032	39.51±0.020	40.00±0.006	46.60±0.006	46.76±0.015	46.03±0.672
	1 %	39.00±0.006	38.20±0.023	38.16±0.021	46.36±0.015	45.15±0.026	45.30±0.020
	3 %	38.90±0.022	38.40±0.015	38.20±0.015	45.51±0.006	45.55±0.021	44.85±0.021
	5 %	38.50±0.015	38.10±0.023	38.00±0.006	46.35±0.032	45.60±0.006	45.03±0.028

Table 4: Mean comparison of Acid detergent fiber of mott grass silage

Stage of cut	***Mean* (%)**
45 days	38.64[b]
60 days	45.72[a]
Additives	
Molasses	42.14[b]
Corn	42.22[a]
Level of additives	
0 %	43.06[a]
1 %	42.08[b]
3 %	41.88[c]
5 %	41.70[d]
Fermentation periods	
30 days	42.57[a]
35 days	42.01[b]
40 days	41.97[b]

Values with different superscripts differ significantly (P <0.05)

Table 5: Cellulose (%age) of mott grass silage as affected by level of additives and fermentation period

Additives	Levels	45 days stage of cut Fermentation periods			60 days stage of cut Fermentation periods		
Molasses		**30**	**35**	**40**	**30**	**35**	**40**
	0 %	38.48±0.173	38.71±0.020	38.81±0.020	41.00±0.006	41.21±0.026	41.26±0.021
	1 %	38.10±0.023	37.93±0.021	38.47±0.006	40.95±0.021	40.38±0.015	40.84±0.015
	3 %	38.23±0.017	37.89±0.026	38.26±0.021	40.75±0.023	39.85±0.031	40.60±0.018
	5 %	37.95±0.021	37.91±0.020	37.83±0.021	40.78±0.020	40.55±0.006	39.20±0.023
Corn	0 %	38.68±0.021	40.00±0.006	39.91±0.015	40.10±0.022	40.15±0.015	40.10±0.023
	1 %	38.43±0.021	38.32±0.018	37.53±0.032	39.95±0.006	40.91±0.020	40.15±0.021
	3 %	37.85±0.021	38.61±0.026	38.28±0.012	40.58±0.019	39.10±0.026	40.51±0.026
	5 %	38.23±0.025	37.82±0.059	38.44±0.015	40.16±0.021	40.65±0.006	40.13±0.006

additives on the fiber contents during ensiling. Yang *et al*., (2004) pointed out that the NDF and ADF concentrations in silages were diluted (P<0.05) by the addition of additives. Similarly, comparison of herbage and silages indicated that ensiling resulted in a clear decrease in NDF concentrations. This might be due to the acids produced during fermentation that hydrolyzed NDF (Jaakkola *et al*. 2006). Hydrolysis of NDF-bound N during ensilage may account for a major part of the reduction in NDF concentration (Jones *et al*., 1992; Rinne *et al*., 1997). Hemicellulose also undergoes considerable breakdown by enzymatic action during the early stages of ensiling which is gradually suppressed by acid hydrolysis (Woolford, 1984). Bolsen, (1995) pointed out that lower pH levels increased chemical hydrolysis of some polysaccharides which can reduce the fiber content of the ensiled forage.

Table 6: Mean comparison of cellulose of mott grass silage

Stage of cut	*Mean* (%)
45 days	38.36[b]
60 days	40.41[a]
Additives	
Molasses	39.41[a]
Corn	39.39[a]
Level of additives	
0 %	39.86[a]
1 %	39.33[b]
3 %	39.21[c]
5 %	39.23[c]
Fermentation periods	
30 days	39.38[a]
35 days	39.37[a]
40 days	39.39[a]

Values with different superscripts differ significantly (P <0.05)

Acknowledgement: This study was supported by Agricultural Linkage Program (Pakistan Agricultural Research Council) Islamabad, Pakistan.

REFERENCES

Abou-Roya, A. K., R. H. Habib, W. H. Abdel-Malik, A. M. Makkay and M. K. Hathout (1973). Effect of chopping and molasses addition on the nutritional qualities of trench silage prepared from first cut of red clover rye-grass mixture. Agric. Res. Rev., 51, 41-60.

Acosta, Y. M., C. C. Stallings, C.E. Polan, and C. N. Miller, (1991). Evaluation of Barley silage harvested at boot and dough stages. J. Dairy Sci. 167-176.

Bilal, M. Q. (1998). Studies on the production potential of mott dwarf elephant grass and its feeding value in lactating Nili-Ravi buffaloes. PhD thesis, Department of Livestock Management, University of Agriculture Faisalabad.

Bolsen, K. K. (1995). Silage: Basic Principles. *In:* Barnes, R. F. *et al*. (ed.) *Forages:* the science of grassland agriculture. Ames: Iowa State University Press, p. 163-176

Coblentz, W. K., J. O. Fritz, W. H. Fick , R. C. Cochran and J .E. Shirley (1998). In situ dry matter, nitrogen and fiber degradation of alfalfa, red clover and eastern gamagrass at four maturities. J. Dairy Sci. 81: 150-161.

De-Boever, J. L., D. L. De-Brabander , A. M. De-Smet, J. M. Vanacker, and C. V. Boucque (1993). Evaluation of physical structure. 2. Maize silage. J. Dairy Sci. 76: 1624-1634.

Gordon, H. K. (1989). An evaluation through lactating cows of a bacterial inoculant as an additive for grass silage. Grass Forage Sci. 44: 169-176.

Jaakkola, S., V. Kaunisto and P. Huhtanen (2006). Volatile fatty acid proportions and microbial protein synthesis in the rumen of cattle receiving grass silage ensiled with different rates of formic acid. Grass and Forage Sci. 61: 282-393.

Johnson, L. J. H., C. Harrison, K. Hunt, C. G. Goggett and D. Sapienza (1999). Nutritive value of corn silage as affected by maturity and mechanical processing. J. Dairy. Sci. 82: 2813-2825.

Jones, B. A., R .D. Hatfield and R. E. Muck (1992). Effect of fermentation and bacterial inoculation on Lucerne cell walls. J. Sci Food Agri. 60: 147-153.

Kung Jr., L .J. R. Robinson, N. K. Ranjit, J. H. Chen, C. M. Golt and J. D. Pesek (2000). Microbial populations, fermentation end-products and aerobic stability of corn silage treated with ammonia or a propionic acid based preservative. J. Dairy Sci. 83, 1479-1486.

Lattemae, P., C. Ohlsson and P. Lingvall (1996). The combined effect of molasses and formic acid on quality of red-clover silage. Swedish J.Agric.Res.26,31-41.

Nelson, W. F. and L. D. Satter (1992). Impact of stage of maturity and method of preservation of alfalfa on production by lactating dairy cows. J. Dairy. Sci. 73: 1800-1807.

Panditharatne, S., V. G. Allen, J. P. Fontenol, and M. C. N. Jayasuria (1986). Ensiling characteristics of tropical grasses as influenced by stage of growth, additives and chopping length. J. Anim. Sci. 63: 197-207.

Rinne, M., S. Jaakkola and P. Huhtanen (1997). Grass maturity effects on cattle fed silage based diets. 1. Organic matter digestion, rumen fermentation and nitrogen utilization. Ani. Feed Sci. and Tech. 67: 10-17.

Rooke, J. A., F. M. Maya, J. A. Amold, and D. G. Armstrong (1988). The chemical composition and nutritive value of grass silages prepared with no additive or with the application of additives containing either *Lactobacillus plantarum* or Formic acid. Grass Forage Sci. 43: 87-95.

Shepherd, A. C. M. and L. Kung (1996). An enzyme additive for corn silage: Effects on silage composition and animal performance. J. Dairy Sci. 71: 1556-1568.

Steel, R. G. D., J. H. Torrie and D.A. Dickey (1997). Principles and Procedures of Statistics, Biometrical Approach. 3rd Ed. McGraw Hill Book Co. Inc., New York, U.S.A.

Tamada, J., H. Yokota and M. Ohsima (1999). Effect of additives, storage temperature and regional difference of ensiling on the fermentation quality of Napier grass (*Pennisetum purpureum)* silage. Asian-Austral. J. Anim. Sci.12: 28-35.

Van Soest, P. J., H. B. Robertson and B. A. Lewis (1991). Methods of dietary fiber, NDF and non-starch polysaccharides in relation to animal material. J. Dairy Sci., 74: 3583-3590.

Woolford, M. K. (1984). The Silage Fermentation. Marcel Dekker Inc. 270. Madison Avenue, New York.

Yang, C.M., J. S. Haung, C. T. Chang, Y.H. Cheng and C.Y. Chang (2004). Fermentation acids, aerobic fungal growth and intake of napier grass ensiled with nonfiber carbohydrates. J. Dairy Sci. 87:630-636.

Yokota, H., T. Okajima and M. Ohshima (1991). Effect of environmental temperature and addition of molasses on the quality of Napier grass (*Pennisetum purpureum.*) silage. Asian-Austral. J. Anim. Sci. 4: 377-382.