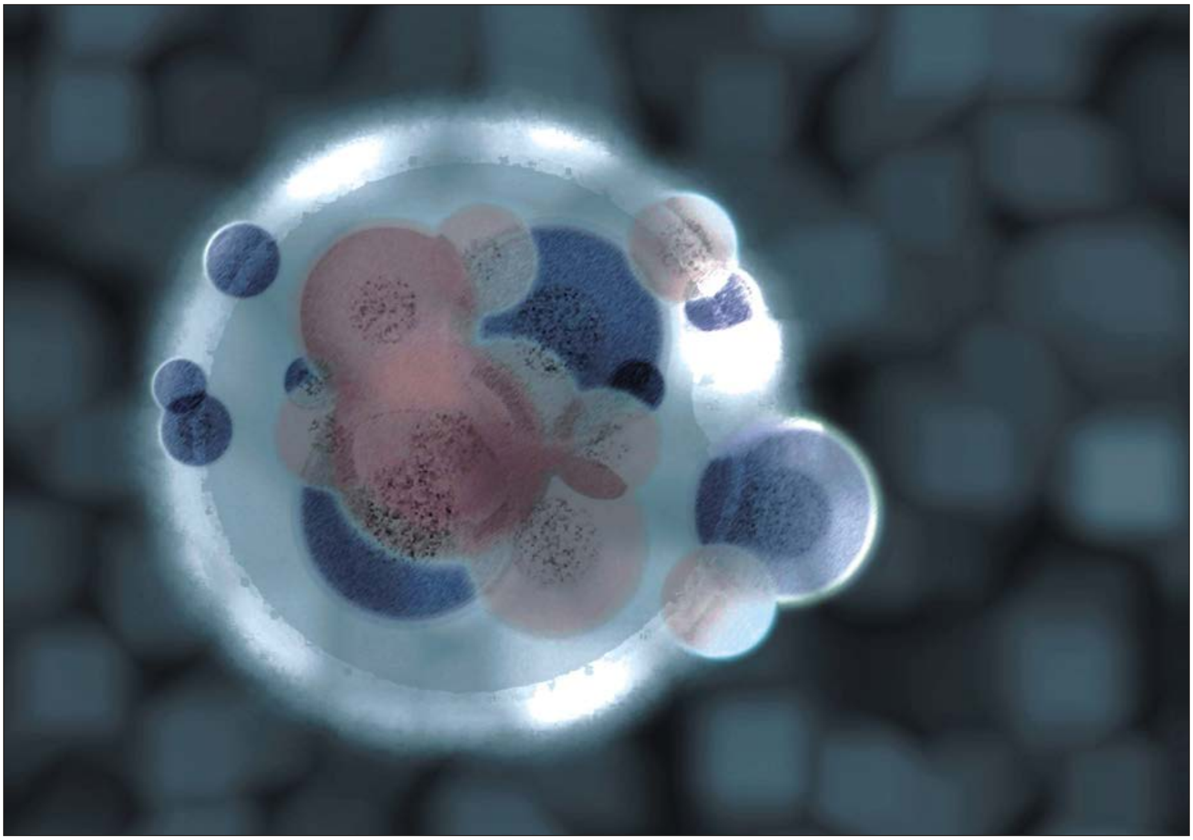

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# Effects of Urea, Molasses and Urea Plus Molasses Supplementation to Sorghum Silage on the Silage Quality, *in vitro* Organic Matter Digestibility and Metabolic Energy Contents

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**Abstract:** Silage type sorghum harvested at milk stage were ensiled for 70 days with no additive or differing levels of Urea (U), Molasses (M) and Urea+Molasses (U+M) to determine silage quality, *in vitro* organic matter digestibilities (IVOMD) and metabolic energy contents (ME). According to physical properties, all silages are either excellent or satisfactory. While addition of urea decreased organic matter digestibilities and metabolic energy contents of the silages, it was not negatively affect fermentation quality. It has been noted that it is possible to produce high-quality silages with all of the additives and 0.5U%+5M% addition into silages produced the best quality silages in terms of fermentation quality criteria, organic matter digestibility and metabolic energy contents.

**Key words:** Sorghum silage, urea and molasses additive, *in vitro* organic matter digestibility, metabolic energy

## INTRODUCTION

The purpose of using additive in silage making is mostly to increase the quality of silage (Muck, 1996). Urea has been used to increase nitrogen content of forage such as sorghum (Filya, 2001). However molasses have been used to supply energy source that can fastly be fermented into lactic acid by lactic acid bacteria and to increase the dry matter content of forage (Thomas *et al*., 2003).

In this study, it is aimed to determine the effects of additional of urea, molasses, urea+molasses in different levels into sorghum forage harvested at milk stage on silage quality, *in vitro* organic matter digestibility and metabolic energy contents.

## MATERIALS AND METHODS

Sorghum forage harvested with silotrack at milk stage and ensiled for total 16 silage samples with 5 replications and each sample was tightly filled in one liter jars. Silage samples such as control (no additive), urea, molasses and urea plus molasses at different rates [0.5%, 1, 1.5 Urea (U); 5%, 10, 15 Molasses (M) and 0.5U%+5M%, 0.5U%+10M%, 0.5U%+15M%, 1U%+5M%, 1U%+10M%, 1U%+15M%, 1.5U%+5M%, 1.5U%+10M%, 1.5U%+15M% urea+molasses (U+M) ] were prepared on fresh material basis.

Physical features such as color, smell, structure, total point and quality classifications of the silages opened after 70 days of fermentation period were made by DLG and Flieg point system (Kiliç, 1986). In the silage samples prepared, Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Crude Fat (CF) and crude ash analyses were made according to Weende analyze method (Bulgurlu and Ergül, 1978), Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) analyses according to Van Soest and Robertson (1979). pH levels were measured immediately, silage liquid was obtained and filtered silage liquids were stored in deep freezer until organic acids analysis (Hart and Horn, 1987). Acetic, butyric and propionic acid levels were made by Gas Chromatography (Dawson and Mayne, 1995) and lactic acid analyses in Spectrophotometer by RANDOX lactate kit.

*In vitro* Dry Matter Digestibility (IVDMD) of silage samples were determined by the procedure of Tilley and Terry (1963). Ruminal ingesta from an alfalfa-fed ruminally fistulated ram was hand-collected and strained through four layers of cheesecloth to provide the innocula for IVDMD determination.

Data analysis are determined according to $Y_{ijk} = \mu + \alpha_i + e_{ijk}$ linear model, $Y_{ijk}$: I. In additional demonstration, j: represents observation value, $\mu$: general average, $a_i$: I. effect of additional activity, $e_{ijk}$: I. represents j. chance depended fault term for observation value in additional

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matter activity. The difference among control and additional matter groups is determined by applying DUNNET test (Steel *et al*., 1997). The comparison of additional matter including groups within themselves is found out by Duncan multiple comparison test method (Düzgüneş *et al*., 1978). In the calculations, MINITAB for windows statistical package program was used (Anonymous, 2000).

## RESULTS AND DISCUSSION

Chemical composition of sorghum silages with urea, molasses and urea plus molasses additive in Table 1 is given.

All of sorghum silages with urea, molasses and urea plus molasses additive at different level were satisfactory or excellent in term of flieg point and quality (Table 2). it has been noted that there was positive correlation between silage fermentation quality and quality class of silage (Alçiçek and Özkan, 1997; Bakici and Demirel, 2004).

pH of 1.5U%+10M% silage was 4.41 and was higher than control and other groups, however no difference between control group and other silages occur. When molasses addition increased from 5 to 15%, pH decreased ($p<0.05$), increase in the dose of urea made no change in pH (Table 3). Many studies have reported that addition of urea or urea+molasses into corn or sorghum silages increased silage pH (Demirel *et al*., 2003, 2004; Nursoy *et al*., 2003). It were reported by some researchers that urea buffered the decrease in pH level but molasses stimulated it (Kılıç, 1986; Bolsen *et al*., 1985).

Acetic acid concentration of 1U% (6.24%), 1U%+10M% (7.29%) and 1.5U%+10M% (6.55%) silages were higher than control silage ($p<0.05$) where as no difference between control silage and other silage groups occurred. Increasing levels of urea and molasses in silages made no a linear change in acetic acid concentrations. A higher level of acetic acid concentrations confirmed the idea presence of a heterofermentative fermentation (Woolford, F). While a considerable difference among control group, 1.5U%+10M% (0.50%) and 0.5U%+10M% (0.41%) silage groups in terms of propionic acid concentrations was found ($p<0.05$), there weren't any difference among other silage groups. Increasing levels of urea and molasses have no effect on propionic acid levels. Butyric acid levels of silages showed no a linear distribution like in acetic acid levels. Butyric acid concentrations of 0.5U%+10M% (1.67%), 1.5U%+10M% (1.44%), 1U%+15M% (1.29%) and 1U%+10M% (1.19%) silages were higher than control silage and no considerable difference was observed among control and all other silage groups ($p<0.05$). Increasing levels of urea and molasses did not affected butyric acid concentrations.

Table 1: Chemical composition of sorghum silage prepared with no additive, addition of urea, molasses and urea+molasses at different levels (DM%)

| Silage groups | DM | CP[1] | CF | ADF | NDF |
|---|---|---|---|---|---|
| Control | 22.08 | 1.91 | 1.20 | 40.88 | 56.06 |
| 5M% | 22.51 | 2.06 | 1.25 | 39.64 | 55.81 |
| 10M% | 21.64 | 3.10 | 1.12 | 39.35 | 54.12 |
| 15M% | 22.54 | 3.02 | 2.00 | 34.63 | 49.79 |
| 0.5U% | 22.70 | 4.13 | 2.05 | 35.66 | 54.87 |
| 1U% | 22.66 | 3.68 | 1.62 | 36.87 | 59.72 |
| 1.5U% | 22.38 | 3.50 | 1.59 | 36.18 | 53.46 |
| 0.5U%+5M% | 22.72 | 2.13 | 1.00 | 34.62 | 52.74 |
| 1U%+5M% | 22.61 | 2.37 | 1.11 | 35.09 | 50.64 |
| 1.5U%+5M% | 24.26 | 2.80 | 0.96 | 33.81 | 51.26 |
| 0.5U%+10M% | 22.74 | 2.46 | 1.15 | 36.12 | 53.14 |
| 1U%+10M% | 23.19 | 2.77 | 1.37 | 35.95 | 53.75 |
| 1.5U%+10M% | 21.19 | 2.77 | 1.09 | 37.58 | 58.05 |
| 0.5U%+15M% | 22.25 | 2.51 | 1.02 | 35.96 | 51.94 |
| 1U%+15M% | 22.01 | 2.36 | 1.08 | 36.30 | 54.80 |
| 1.5U%+15M% | 23.17 | 2.93 | 1.05 | 35.27 | 50.63 |

[1]Wet material

Lactic acid concentration of the control silage (2.47%) was lower than the concentrates of 5M% (3.58%), 1U% (3.48%) and 0.5U%+5M% (4.25%) silages ($p<0.05$), the differences among control and other mixtures were not significant.

However true organic matter digestibility of the control silage (63.33%) was higher than that of 1.5U% (46.47%) silage ($p<0.05$), no difference found among control with other silage groups. Metabolic energy levels of control silage (2.66 kcal $kg^{-1}$) was lower than that of 1U% (2.28 kcal $kg^{-1}$), 1.5U% (1.91 kcal $kg^{-1}$) and 1.5U%+15M% (2.14 kcal $kg^{-1}$) silages ($p<0.05$), no difference found among control with other silage groups. While increasing molasses levels did not affect organic matter digestibility and metabolic energy levels, increasing urea levels decreased organic matter digestibility and metabolic energy levels.

Factors such as maturity of plant at harvesting, additives used and differences in nutrient contents of green herbage can affect the digestibility, thus metabolic energy contents of green herbage. Furthermore, use of urea as silage additive did not accelerate organic matter digestibility of the silages, but addition of molasses into silages have been reported to increase and metabolic energy levels of by increasing hydrolysis of cell wall (Seoane *et al*., 1992; Petit and Veira, 1994).

Molasses had no negative effects on silage quality, true digestibility organic matter and metabolic energy levels compared with control silage, increasing urea levels decreased the true digestibility organic matter and metabolic energy levels of silages.

Table 2: Physical characteristic and quality classification of sorghum silage prepared variable shape

| Silage groups | Smell | Structure | Color | Total point | Quality class | Flieg point | Quality class |
|---|---|---|---|---|---|---|---|
| Control | 14 | 4 | 2 | 20 | Excellent | 86.72 | Excellent |
| 5M% | 8 | 4 | 2 | 14 | Satisfactory | 83.92 | Excellent |
| 10M% | 8 | 4 | 2 | 14 | Satisfactory | 90.82 | Excellent |
| 15M% | 8 | 4 | 2 | 14 | Satisfactory | 94.88 | Excellent |
| 0.5Ü% | 14 | 4 | 2 | 20 | Excellent | 91.53 | Excellent |
| 1Ü% | 14 | 2 | 2 | 20 | Excellent | 89.12 | Excellent |
| 1.5Ü% | 14 | 4 | 2 | 20 | Excellent | 84.06 | Excellent |
| 0.5Ü%+5M% | 14 | 4 | 2 | 20 | Excellent | 89.94 | Excellent |
| 1Ü%+5M% | 8 | 4 | 1 | 13 | Satisfactory | 92.52 | Excellent |
| 1.5Ü%+5M% | 8 | 4 | 2 | 14 | Satisfactory | 85.20 | Excellent |
| 0.5Ü%+10M% | 14 | 4 | 2 | 20 | Excellent | 90.24 | Excellent |
| 1Ü%+10M% | 14 | 4 | 2 | 20 | Excellent | 90.38 | Excellent |
| 1.5Ü%+10M% | 14 | 4 | 2 | 20 | Excellent | 72.66 | Good |
| 0.5Ü%+15M% | 8 | 4 | 1 | 13 | Satisfactory | 93.40 | Excellent |
| 1Ü%+15M% | 8 | 4 | 2 | 14 | Satisfactory | 90.52 | Excellent |
| 1.5Ü%+15M% | 8 | 4 | 1 | 13 | Satisfactory | 92.38 | Excellent |

Table 3: Fermentation qualities, IVOMD (DM%) and ME (kcal $kg^{-1}$) values of sorghum silages prepared in variable shape

| Silage groups | N | pH | Acetic acid | Propionic acid | Butyric acid | N | Lactic acid | IVOMD | ME |
|---|---|---|---|---|---|---|---|---|---|
| Control | 5 | 4.08 | 2.67 | 0.01 | 0.47 | 4 | 2.47 | 63.33 | 2.66 |
| 5M% | 5 | 4.15bc | 4.29bcd | 0.06c | 0.62ef | 4 | 3.58*ab | 62.83abcde | 2.57abcde |
| 10M% | 4 | 3.97cd | 1.55e | 0.08bc | 0.61e | 4 | 2.94bcd | 64.68abcd | 2.60abcd |
| 15M% | 4 | 3.88d | 4.53bcd | 0.09bc | 0.90cde | 4 | 3.25bc | 69.92a | 2.78a |
| 0.5Ü% | 5 | 3.97cd | 2.66de | 0.14bc | 0.68ef | 4 | 3.09bcd | 62.15bcde | 2.52abcde |
| 1Ü% | 5 | 4.03bcd | 6.24*abc | 0.02c | 0.84cde | 4 | 3.48*b | 55.68e | 2.28*ef |
| 1.5Ü% | 5 | 4.14bc | 1.70e | 0.09bc | 0.75def | 4 | 2.79bcd | 46.47*f | 1.91*g |
| 0.5Ü%+5M% | 5 | 4.01cd | 4.31bcd | 0.07bc | 0.28fg | 4 | 4.25*a | 67.47ab | 2.71abc |
| 1Ü%+5M% | 4 | 3.99cd | 4.55bcd | 0.13bc | 0.13g | 4 | 3.03bcd | 61.07bcde | 2.44cde |
| 1.5Ü%+5M% | 5 | 4.21b | 5.35bc | 0.12bc | 0.15g | 4 | 2.53cd | 60.01cde | 2.42cde |
| 0.5Ü%+10M% | 4 | 3.94d | 5.19bc | 0.41*ab | 1.67*a | 4 | 2.28cde | 57.65de | 2.32def |
| 1Ü%+10M% | 4 | 4.06bcd | 7.29*a | 0.15bc | 1.19*bcd | 4 | 2.46d | 65.66abc | 2.68abc |
| 1.5Ü%+10M% | 4 | 4.41*a | 6.55*ab | 0.50*a | 1.44*ab | 4 | 2.87bcd | 68.15ab | 2.76ab |
| 0.5Ü%+15M% | 4 | 3.93d | 4.02cd | 0.00c | 0.72def | 4 | 2.47cd | 67.80ab | 2.70abc |
| 1Ü%+15M% | 5 | 3.96cd | 4.98bcd | 0.21abc | 1.29*abc | 4 | 1.62e | 60.18cde | 2.48bcde |
| 1.5Ü%+15M% | 5 | 3.97cd | 4.17bcd | 0.08bc | 0.79de | 4 | 2.57cd | 59.27cde | 2.14*f |
| SEM | | 0.118 | 1.499 | 0.207 | 0.305 | | 0.475 | 4.347 | 0.176 |

*: The difference of control group average at each column is important ($p<0.05$). a, b, c, d, e, f: values with different superscripts in the same column differ significantly ($p<0.05$)

In conclusion, although sorghum forage can be ensiled without any additives, 0.5% urea or 5% molasses alone or combination of them may enhance the silage quality of sorghum based on parameter examined in this study.

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