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The Effects of Certain Additives on the Grass Silage Quality, Digestibility and Rumen Parameters in Rams

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Abstract: In this study, the effects of certain additives put into grass silage on the both nutrient contents and pH value of silage and digestibility and rumen parameters on rams were examined. Grass silage and grass silage mixed with silage additives of 4% crushed barley, 2% molasses and 1% salt were placed into plastic barrels and their Dry Matter (DM), Organic Matter (OM), ash, Crude Protein (CP), Crude Fiber (CF) and Ether Extract (EE) contents were examined. In addition, silage digestibilities of DM, OM and CP and the effects of silages on ruminal pH, ammonia N and volatile fatty acid contents were also determined. While, DM and ash contents of silage were increased, CP content and ruminal pH were decreased in the silage prepared with silage additives. DM and OM digestibilities have been determined to be significantly higher ($p<0.05$) in additive silage, as compared to that of the grass silage. CP digestibility has not been changed in both experimental groups. Ruminal pH and isovaleric acid value of the silage prepared with additives were decreased, but propionic acid value was increased ($p<0.05$). There were no differences on the values of rumen ammonia N, acetic acid, butiric acid and valeric acid. In conclusion, silage additives positively affected the digestibility and rumen fermentation products.

Key words: Grass silage, nutrient contents, digestibility, rumen parameters, fatty acid, dry matter

INTRODUCTION

Ensiling, the method of conserving green forage, comprises certain beneficial aspects as compared to hay making. For this reason, the usage of silage is very essential in ruminant nutrition (Akyildiz, 1986). Grasses, constitute major of forages, are included of middle level ensilage forages depending on proportion of graminea and leguminosea. The easily obtained feed sources such as cereal grains, molasess and salt are usually added to silage for practicing ensiling and increasing the quality of these kinds of forages for the aspect of increasing microbial fermentation and eliminating microbial toxins (Akyildiz, 1986; Jacobs *et al*., 1995; Kaya *et al*., 2009).

Dry Matter (DM) and nutrient contents of the grass silage and its pH level vary depending on the kind, vegetation period and silage additives (Haigh *et al*., 1985; More *et al*., 1986; Rinne *et al*., 2002; Cone *et al*., 1999; Baytok and Muruz, 2003). In a study, where three different silage samples of mixed grasses were made of the DM contents were determined as 34.3, 29.9 and 38.8%, CP as 8.12, 9.37, 11.87% and pH as 4.6, 4.6, 4.4 (Moore *et al*., 1986). They determined the DM digestibility of same silages to be 52.3% in lambs. Likewise, Rinne *et al.* (2002) measured CP and pH levels of the silage samples made of grass from late vegetation period to be 11.3% and 4.10, respectively. Increasing consumption of the grass silage that contain 21.6% DM and 11.6% CP by had no profound differences among the acetic, propionic and butyric acids amounts in the rumen fluid samples of rams (Friggens *et al*., 1998).

Grass hay is very vital in the East Anatolia of Turkey for livestock production. Forage requirement of ruminants are mostly acquired from grass hay in the Winter season in this region because of the limited grass silage production. The usage of grass silage is expected to increase the animal production and to preserve loses of nutrients in grass.

The objective of this study was to determine the effects of some additives supplemented into grass silage on the both nutrient contents and pH values and on the digestibility rates and rumen parameters on rams.

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MATERIALS AND METHODS

Animals and experimental procedures: Grass was harvested in 25 July 2003 and cut into average of 3 cm pieces. The sole Grass Sample (GS) and grass samples mixed with silage additives of 4% crushed barley, 2% molasses and 1% salt (AGS) were placed into plastic barrels. Molases was diluted proportion of 1/3 with water and added into mixture. Silages were opened in May 2004, analyzed and after used in this study.

For the animal experiments, eight Tushin rams (46.12±0.69 kg) were divided into two equal groups. They were housed individually in pens and fed twice a day at 08.30 and 17.00. Grass silage was offered 2.5 kg/animal/day and fresh water was available to the lambs at all times. The experiment lasted total a 17 day period consisting of a 12 days diet adaptation period and a 5 days measurement period.

Determinitation of the nutrient contents and pH of silage: Silage samples were dried in air forced oven at 60°C for 48 h. Then, contents of the Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF), ash and Nitrogen Free Extract (NFE) were determined in accordance with the AOAC (1990). Values of the DM, OM and CP of the fecal samples were also acquired by the same method.

To determine the pH, 25 g silage sample and 100 mL distile water were put in a beaker. After stirring up the content for 10 min, the pH was measured by the indicated method Polan *et al.* (1998) using pH meter (Accumet, Fischer Scientific, USA).

Determination digestibility and rumen parameters: For digestibility trial, each animal's faces was weighed daily and a 10% aliquot retained, composited and frozen (-20) for 5 days. Composited samples were subsequently dried in a forced air oven at 60°C at 48 h. Apparent dry matter, organic matter and crude protein, digestibilities were determined.

On the final day of the experiment, an amount of 40 mL ruminal fluid samples was obtained from each animal through the rumen tube 2 h after the morning feeding. The pH was determined with pH meter (Accumet, Fischer Scientific, USA) immediately. Then, the samples were divided into two different 20 mL bottles.

Rumen ammonia N was determined by description of Markham (1942) from the 20 mL rumen fluid samples. The remaining of the 20 mL of ruminal fluid samples was treated with 1 mL of a 25% (w v^{-1}) dilution of metaphosphoric acid per 4 mL of ruminal fluid and was stored at -20°C for volatile fatty acids analysis, as indicated by Horney *et al.* (1994). Volatile fatty acid concentrations were also analyzed in gas chromatography (Agilent 6980 N, USA) with using 30 m × 0.53 mm (id) capillary colon (Restek Corp. Canada).

Statistical analysis: Data of nutrient content of silages were submitted as mean analysis. t-test was used to identify differences of digestibility and ruminal pH, VFA and NH_3-N in between the groups (SPSS 12.0). Data were represented as mean±SEM.

RESULTS

Nutrient contents and pH value of grass silages are shown in Table 1. The apparent digestibilities of DM and OM were significantly higher in the additive silage, comparing with that of silage only experiment. However, CP digestibility has not been changed in any experimental groups Table 2. The values of ruminal pH, ammonia N and VFA's in sheep fed with silages are shown in Table 3. Ruminal pH was lower in rams fed with additive grass silage than that of grass silage ($p<0.05$). There was no different ruminal NH_3-N and acetic, butyric, valeric acid levels within groups.

Table 1: Chemical composition and pH values of silages

Items	GS	AGS
Dry matter (%)	36.96	43.14
Organic matter	92.06	88.33
Ash	7.94	11.67
Crude protein	8.91	7.91
Crude fiber	36.09	37.82
Ether extract	4.22	3.77
Nitrogen free extract	42.84	38.83
pH	5.72	4.16

Table 2: Digestibilities of silages in groups (%)

Digestibility (%)	GS	AGS
Dry matter	67.84±1.95	76.88±0.71*
Organic matter	67.67±2.03	74.43±0.80*
Crude protein	60.39±2.31	62.48±2.26

*There are significant differences between groups ($p<0.05$)

Table 3: Ruminal pH, NH_3-N and VFA levels in groups

Rumen parameters	GS	AGS
pH	6.84±0.10	6.40±0.02*
NH_3-N (mg L^{-1})	252.5±30.10	232.5±22.50
Volatile fatty acid (mmol L^{-1})		
Acetic acid	52.72±5.39	57.51±4.80
Propionic acid	11.66±0.78	15.15±1.02*
Butyric acid	6.01±0.86	8.43±0.73
Izovaleric acid	1.68±0.11	1.02±0.07*
Valeric acid	1.46±0.11	1.31±0.03

*There are significant differences between groups ($p<0.05$)

DISCUSSION

The DM and nutrient contents of the silages were affected by the additivites used. The DM level of additives added to silages was determined as 43.14%. This value was higher than that of the silage without additives. The ash and CF levels were higher in the grass silage samples with additives, as compared to those without additives. Contrarily, the CP and EE levels were lower in the grass silage samples with additives. The DM content of the sole grass silage samples of this study was higher than that of Kaya *et al.* (2009), who siloed the same area grass, but CP, CF, EE and NFE levels were similar.

Yet, DM and CP values were lower than those of Baytok and Muruz (2003). The DM levels of the grass silages documented in this study were in similar with those reported by Cone *et al.* (1999), which were harvested in different vegetation periods, but CP levels were higher than those we found in the study. In the study of More *et al.* (1986), which supports the results of the study, the DM and CP levels were found as 34.3% and 8.12% sequentially. The DM level variation in between the findings of the study and literature reports may be explained through the fact that we used grass samples that contained high percentage of graminae species, as also indicated by Kaya *et al.* (2004).

The pH value of non supplemented grass silage sample was determined to be high whereas that of the supplemented grass silage sample was found as 4.16. It was 5.72, which was in parallel with the findings of the study of Cone *et al.* (1999), who made of silages with the grass samples from different vegetation periods (4.41-6.18). On the other hand, pH level of supplemented silage samples was similar to the data (4.10) of Rinne *et al.* (2002), who used hay samples from very late vegetation period. Moreover, the results of another study More *et al.* (1986) performed to make three different grass silages (4.6, 4.6 and 4.4), were also in between the limits of the findings. The over all results of Kaya *et al.* (2009), which had been performed previously in the same area, were also parallel to the current findings.

Supplementation to the grass silage significantly increased digestibility of the DM and OM, but had no effect on CP digestibility. We can conclude that the results of Rinne *et al.* (2002) on the OM and CP digestibilities (72.3, 66.2%) are harmonical with the findings. However, the DM digestibility of the grass silage prepared in the study of Moore *et al.* (1986) (52.3%) on lambs are lower than results. They have also found the levels of ruminal pH, acetic, propionic, butyric, valeric and isovaleric acids are 6.29 and 659, 161, 135, 15.8 and 12.9 mmol mol^{-1} sequentially in the cattle fed with the same silage. These results are partially similar with the data. Friggens *et al.* (1998) determined the levels of acetic, propionic and butyric acids in the ruminal fluid taken 4 h after feeding with grass silage as 68.10, 21.5 and 7.06 mol/100 mol, some of which are in parallel with the findings.

CONCLUSION

Consequently, grass silages at good qualities, either without supplementation or supplemented with barley, molasses and salt have significant beneficial effects on digestibility and rumen fermentation products. Yet, the grass silages supplemented with the indicated feed stuffs have even better results.

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