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THE EFFECTS OF SILAGES OF DIFFERENT QUALITY ON FEEDLOT PERFORMANCE AND NUTRIENT DIGESTIBILITY IN LAMBS

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Summary

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This study was conducted to determine the effects of silages of different quality mixed at different changed ratios on food intake, live weight gain, feed conversion and nutrient digestibility in lambs. A mixture of green barley and vetch was used as silo material (in a 50/50 ratio). In this study 24 male lambs with average weight 43.46 kg and 11 months of age were used. The lambs were assigned randomly in three groups. Group I was given concentrate feed + *A* quality silage 100 %; group II received concentrate feed + *A* quality silage 25 % + *B* quality silage 75 %; group III was fed concentrate feed + *A* quality silage 50 % + *B* quality silage 50 %.

Dry matter (DM) of *A* and *B* quality silages were determined as 35.10 and 40.86 % respectively. The pH, NH3-N and lactic acid levels of *A* quality silage were 4.48 %, 0.40 % and 2.51 % (DM) and those of *B* silages: 6.10%, 0.86% and 0.44%. respectively. Silage dry matter intakes (DMI) of lambs from groups I-III were 646.60, 608.55 and 539.69 g/day respectively and differed significantly between all groups ($p<0.05$). The corresponding values for the total dry matter intakes were 1634.02, 1603.47 and 1592.94 g/day respectively. Average body weight gains (BWG) were 252.77, 241.66 and 244.60 g/day in groups I, II and III, respectively. Feed conversion ratios were 6.69, 6.66 and 6.57 g DMI/g BWG and dry matter, crude protein and crude fiber digestibility were 67.37, 66.27, and 66.69 %; 69.70, 66.61 and 66.60 %; 52.99, 50.52 and 49.44 % in all groups, respectively.

Key words: digestibility, feedlot performance, lambs, silage quality

INTRODUCTION

There are several methods for conservation of forage until it is ready to be used. The goals of either conservation system are the same. First, the quality or feeding characteristics of the forage removed from storage should be very similar to that in which it entered storage. Ideally, any changes in the composition of the forage during storage should not adversely affect any aspect of the forage's use. Second, dry matter (DM) and energy losses should be minimized (Muck, 1988). Silage is one of conservation methods but silage making requires technical tools. In developed countries technological progress helps considerably making a good quality silage, but in developing countries this is not always possible . As a matter of fact, for pit silage, rapid filling, compaction and good sealing are needed. Silage dete-

rioration on exposure to air is inevitable and may result in changes in colour, smell and structure and consequently, change in fermentation process. Aerobic deterioration of silage is manifested by an increase in temperature and pH caused by metabolism of sugars and organic acids by yeasts and bacteria (Sanderson, 1993). Increasing of temperature in silo, not involving the production of lactic acid generates greater amounts of other compounds. Heating results in a toasting effect on the silage, which darkens the colour. High temperature storage reduces the protein digestibility of silage (McDonald, 1981; Alçiçek & Özkan, 1996; Alçiçek & Özkan, 1997; Yüksel, 1997; Kılıç, 1997). These silages are not consumed with appetite by animals and thus, negatively affect the performance of animals (Çerçi *et al*., 1997a).

Our study was conducted to determine the effects of mixing in different ratios of silages taken in air due to technological insufficiency, which were with a brown colour, smell of burning but not moldy on levels of nutrients, digestibility, body weight gain and feed conversion in lambs.

MATERIALS AND METHODS

Feed materials

Whole crop barley-vetch (50/50%) was used as silo material. Whole crop barley-vetch was ensiled in two heap silo with preservative (1% salt and 0,5 % sugar). Silos were opened after 45 days. Five kg samples were taken for analysis (from *A* and *B* quality silages). The silage samples underwent an organoleptic examination for colour (Anonymous, 1987). The same concentrate feed was given to all groups of animals (Table 1).

Animals and experimental design

Twenty four lambs with average body weight of 43.46 kg, divided into 3 groups, were used. Concentrate feed and silages were given *ad libitum*. Group I received 100% *A* quality silage, group II - 75 % *A* quality silage and 25% *B* quality silage, whereas group III - 50 % *A* quality silage and 50 % *B* quality silage. Animals were kept in individual cages. The silages and concentrate were given at different troughs. Dry matter intake was recorded daily. Lambs were removed from the cages every 14 days to be weighed. Feces were collected once daily, weighed, and sampled (averaging 250 g) for determination of DM. Feces were dried at 55 ^{o}C, collected for the 7-days period for each animal and stored for later analyses. The experiment lasted 45 days. The feed:gain ratio – dry matter intake (DMI):average daily gain (ADG) was calculated.

Chemical analysis

Samples of feed and feces, oven-dried at 55 ^{o}C, were used for DM, ash, organic matter (OM), crude protein (CP), ether extract and nitrogen free extract analyses, according to AOAC (Anonymous, 1990) procedures. The procedure of Crampton & Maynard (1970) was used to measure crude fiber content. Silage NH_3-N was measured according to the methods of Annino (1964). Silage lactic acid (Petit & Flipot, 1992) and volatile fatty acids (VFA) were determined by gas chromatography (Leventini *et al.*, 1990).

Statistical analysis

All data were subjected to analysis of variance of SPSS (Anonymous, 1993). Comparisons of treatment means were done using Duncan's multiple range test.

RESULTS

Chemical composition of forages

A quality silage had a higher crude protein but a lower crude fiber content than a *B* quality silage (Table 1).

Silage characteristics

The *A* quality silage had a higher score than the *B* quality silage for colour, smell and structure (Table 2).

pH of the *A* quality silage was lower than that of *B* quality silage (Table 3). The

Table 1. Chemical composition of concentrate and silages

Parameter	Concentrate	*A* Quality Silage	*B* Quality Silage
DM, %	90.36	35.10	40.86
Ash*, %	6.90	10.98	11.10
OM *, %	93.10	89.02	88.90
CP *, %	15.98	8.82	7.14
CF *, %	11.50	27.12	32.38
Ether extract *, %	3.02	2.18	2.00
N-free extract *, %	62.60	50.90	47.38

DM = dry matter, OM = organic matter, CP = crude protein, CF = crude fibre; * on DM basis.

Table 2. Organoleptic examination of silages

Parameters	*A* Quality Silage	Score	*B* Quality Silage	Score
Odour	A light acid, fruit and aromatic odour	14	Severe butyric acid or ammonia, very light acid odour	2
Colour	Colour of green feed	2	Light yellow	0
Structure	A little grown out structure of leaves	2	Too corrupted structure of leaves and stems	1
Total score		18		3

16-20 score: very good ; 0-4 score: useless (suggested by the German Agriculture Organization, DLG; Anonymous, 1987).

Table 3. pH values, ammonia nitrogen and volatile fatty acids concentrations of silages

Parameter	*A* Quality Silage	*B* Quality Silage
PH	4.48	6.10
NH_3-N *	0.40	0.86
Lactic acid *	2.51	0.44
Acetic acid *	1.34	0.15
Butyric acid *	-	0.07

* on DM basis

Table 4. Dry matter intake, body weight gain, feed:gain ratio of lambs. Values are presented as mean ± SD

Parameter	Group I	Group II	Group III
Concentrate intake, g/day (DM)	990.57^{b} ± 64.83	991.77^{b} ± 48.73	1053.26^{a} ± 36.59
Silage intake, g/day (DM)	646.60^{a} ± 11.95	608.55^{b} ± 11.96	539.69^{c} ± 10.98
Total dry matter intake, g/day	1634.02 ± 67.70	1603.47 ± 44.31	1592.94 ± 36.59
Initial body weight, kg	43.75 ± 4.52	43.57 ± 3.11	43.06 ± 3.00
Final body weight, kg	55.12 ± 3.27	54.43 ± 3.29	54.06 ± 2.90
Average daily gain (ADG), g/day	252.77 ± 52.58	241.66 ± 22.68	244.60 ± 17.80
Feed:gain ratio, g DMI/g ADG	6.69 ± 1.55	6.66 ± 0.56	6.57 ± 0.50

Means within the same line with a different letter differ significantly at $P<0.05$.

Table 5. Whole tract digestibility, %. Values are presented as mean ± SD

Parameters	Group I	Group II	Group III
Dry matter	67.37 ± 1.34	66.27 ± 0.93	66.69 ± 0.77
Ash	50.64 ± 1.78	51.83 ± 1.06	50.52 ± 2.54
Organic matter	68.87 ± 1.29	67.55 ± 0.91	68.25 ± 1.15
Crude protein	69.70 ± 2.74	66.61 ± 4.28	66.60 ± 0.74
Crude fiber	52.99 ± 2.19	50.52 ± 1.72	49.44 ± 3.64
Ether extract	80.04 ± 0.91	80.00 ± 0.82	80.03 ± 0.61
N-free extract	73.01 ± 1.60	72.34 ± 1.03	73.92 ± 2.12

ammonia levels of the *A* quality silage were lower than those of low quality silage. Lactic and acetic acid levels of *A* quality silage were higher than in the *B* quality silage. The butyric acid content of the *A* quality silage was not determined but in *B* quality silage it was 0.07 % (DM).

Dry matter intake and body weight gain

The concentrate intake did not differ between Ist and IInd groups but was statistically significantly different vs group III ($P<0.05$). It was higher for lambs from the IIIrd group. Silage intake was the highest in group I and the lowest in group III, the differences between groups being statistically significant ($P<0.05$). Total dry matter intake did not differ between groups. The changes in BW of lambs and the feed:gain ratio were similar between groups (Table 4).

Digestibility

Whole tract digestibilities of nutrients did not differ between groups (Table 5).

DISCUSSION

The higher score for colour, odour and structure of *A* quality silage in comparison with *B* quality silage is probably due to the heating and the resulting toasting of the latter. The darkening, or browning, could be explained by binding of part of silage carbohydrates with part of the silage protein and the formation of an indigestible compound similar to lignin. Thus, protein tied up by the browning Maillard reaction is relatively unavailable to livestock (McDonald, 1981; Alçiçek & Özkan, 1996; Alçiçek & Özkan, 1997; Yüksel,1997; Kılıç, 1997).

pH of *A* quality silage was lower but lactic and acetic acid levels were higher than that of *B* quality silage which results in more soluble carbohydrate in good quality silage rather than in low quality silage (Akyıldız, 1984). The fermentation processes in silage result in a decreased silage pH and utilization of water-soluble carbohydrates in the reactions. Thus the more complete the fermentation, the fewer soluble carbohydrates remain to participate in the Maillard reaction. Since the rate of fermentation decreases with decreasing moisture content of the silage, it appears that the susceptibility of silages to browning may increase as moisture content decreases. It has also been suggested that the extent of the browning reaction increases with increasing the pH (Muck, 1988; Kılıç, 1997).

NH_3–N level of *A* quality silage was lower than that of *B* quality silage which may be due to fermentation of silage. Proteins are metabolized by butyric acid bacteria to NH_3–N. The level of protein degradation corresponds to the NH_3–N level in silage (Gross & Riebe, 1974). The increase in NH_3–N level in silage demonstrated that butyric acid bacteria counts were higher than normal.

The level of butyric acid in *B* quality silage was an indication for a loss of feed energy content (amounting to 29% at levels of butyric acid higher than 0.4%) (Kiliç, 1986; Çerçi *et al*, 1997b).

The increased concentrate intake in group III may be related to the lower silage intake. The decreased silage intake of the animals from the IIIrd group could be due to color, odour and structure of silage. These characteristics affect considerably the food intake (Sarı & Çerçi, 1993).

Body weight gain and the feed:gain ratio were similar between groups. This may be due to the similar total food intake of groups. The increase in concentrate intake in groups fed a higher *B* quality silage ratio may have neutralized the negative effects of *B* quality silage.

Whole tract digestibilities were similar between groups but those of group I tended to be higher compared to the other groups, which may be due to the higher intake of total dry matter or to intake of *A* quality silage (100 %). The digestibility is affected by silage fermentation. Karabulut *et al.* (1997) demonstrated that the digestibility of silage is reduced by 4 % in clostridial fermentation depending on the predomination of C*lostridium* bacteria in comparison with lactic acid fermentation. Okuyan *et al.* (1986) reported a better digestibility when the content of lactic acid in silage was higher.

This study indicated that the *A* quality silage would always be prefered compared to *B* quality silage for feedlot performance and digestibility in lambs. Furthermore, that the *B* quality silage did not affect negatively these parameters when it was used with 50 % *A* quality silage and concentrate feed in lambs.

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