a percent of live weight at heavier market weights; whereas, cuts (especially shoulder and rack) which tend to deposit more fat within and between the muscles as fattening progresses, will have a slightly increased percent of live weight at the heavier weight. Nevertheless, this data convincingly suggests that ram and ewe lambs can be slaughtered at heavier weights without decreasing the percent closely trimmed major wholesale cuts of live weight. Consequently, this fact implies that the live weight price of the heavier and lighter rams and ewes should be similar since the percent of their live weight going through the retail meat counter is nearly equal.

Corn Silage Additives

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Story in Brief

Six commercial silage additives and ammonium hydroxide were added to whole plant corn silage and fed to lambs. Feed intakes and gains were slightly greater with addition of most additives or with unfermented frozen chopped corn than untreated silage. Some additives show promise in increasing dry matter digestibility. Laboratory analysis of the treated silages indicated that fermentation increased nutritive value of chopped corn at the expense of available carbohydrates, energy and weight. Ammonium hydroxide increased the crude protein content. Fermentation decreased the time before the onset of mold spoilage. Certain silage additives reduced wet matter loss slightly.

Introduction

The addition of additives to alter the fermentation of ensiled chopped corn plants and to increase its nutritive value has been widely practiced with many different commercial products. Some prolong fermentation, some inhibit fermentation and others add nutrients to improve digestion by the animal. Past research has been inconclusive as to the benefit of additives due to different conditions of ensilage and corn moisture in the treated and untreated materials. The objective of this study was to examine the benefit of several commercially available additives on the nutritive value of ensiled whole plant

corn silage by placing the additives on the same chopped material and exposing it to identical ensiling and laboratory conditions.

Materials and Methods

Six commercial silage additives (SJ, SEN, SG, FC IV and SZ) and ammonium hydroxide were added to chopped corn plants (32.2 percent DM) at ensiling in ten double lined plastic bags holding 50 lb each. The control corn silage was allowed to ferment without an additive and one batch of chopped corn was frozen before fermentation. Beginning 284 days later, each of the nine materials was fed to four lambs with a mean weight of 57 lb and intakes were measured for 28 days. The corn silages were *ad libitum* fed with silage weigh-back taken once daily. One-half pound of a 30 percent soybean meal supplement was fed daily. The lambs were weighed every two weeks. The final corn materials were analyzed for dry matter, pH, soluble nitrogen, lactate, energy content, dry matter digestibility and crude protein content. The amount of time before mold growth occurred was measured in a humidor. Feed intake, average daily gain and feed efficiency were determined from the feeding trial. For measurement of energy losses through fermentation, energy content of silage liquids and solids was determined following drying in a special experimental oven. This device, designed by Haskell Edwards, Nutrition Ag. Services, Visalia, California, recondenses the volatiles for measurement.

Results and Discussion

The fresh (unfermented), frozen silage sample dry matter content was higher than all fermented materials. This is due to formation of heat volatile substances and gases by fermentation. The SZ and SG treated silages had lower dry matter content while FC, SJ and SEN had higher dry matter content than the other silage treatments. The pH of the fresh frozen material was higher than the other treatments but lower than neutrality (pH 7.0) suggesting that fermentation had begun between chopping and freezing despite addition of dry ice. The ammonium hydroxide treated corn silage also was higher than the other additives, possibly due to buffering by this material. SEN, SG and FC exhibited lower lactate levels than silage treated with the other four additives, suggesting that fermentation may have been altered by these additives.

The ammonia treated silage had higher and fresh frozen silage had lower crude protein content than other silages. Addition of ammonia would be expected to increase crude protein content and prolong fermentation. The fresh frozen material had lower soluble nitrogen content than fermented material. Solubilization of nitrogen through fermentation is commonly reported. This may act as a non protein nitrogen source in the rumen, but is probably of less value when solubilized than if insoluble and yet digestible in

Table 1. Chemical composition of fermented corn silage

Treatment	Dry Matter (%)	pH	Soluble nitrogen (% of C.P.)	Crude protein (%)	Lactate (% of DM)	Energy content	
						solid (kcal/g)	liquid (kcal/g)
Fresh frozen control	32.2	4.31	34.4	5.9	0.0	3760	85
Fermented control	29.2	3.74	63.9	7.7	3.1	3931	46
SG	28.7	3.71	61.2	8.0	2.2	3939	95
SZ	28.4	3.72	59.1	7.8	2.6	3881	105
SJ	29.8	3.74	62.9	7.4	2.9	3964	61
IV	28.9	3.69	61.5	7.2	3.7	3860	52
SEN	30.4	3.73	61.3	7.1	2.3	3945	94
NH_4OH	29.1	3.96	63.5	9.3	2.8	4079	63
FC	29.9	3.70	58.3	7.6	1.9	3930	53

Table 2. Feeding trial results with fermented whole corn plant silage

Treatment	Level of addition (lb/ton)	Feed intake (lb DM)	Daily gain (lb/day)	Feed/gain (DM basis)	Digestible organic matter intake (lb/day)	In vitro dry matter digestibility (%)
Fresh frozen control	N/A	1.89	.37	5.3	1.32	67.6
Fermented control	N/A	1.67	.24	6.3	1.12	63.4
SG	1.00	1.72	.37	4.7	1.23	70.2
SZ	.01[a]	1.78	.44	4.3	1.28	68.8
SJ	.75	1.83	.40	4.6	1.28	67.2
IV	1.00	1.87	.35	5.6	1.28	64.7
SEN	.75	1.83	.33	5.9	1.32	70.4
NH_4OH	17.0	1.69	.37	5.1	1.17	64.4
FC	1.00	1.72	.35	5.0	1.23	68.4

[a]Mixed 20 lb of SZ with one ton of wheat middlings, then use one pound/ton of silage.

the intestines. The increase in soluble nitrogen with the silage additives did not appear to depress feed intake by sheep.

All silages with additives had more energy content in the dried solids. This will make feed efficiency when calculated on a dry matter basis higher following fermentation. SG, SZ and SEN appeared to have higher energy content in the volatile liquid fraction.

Feed intake and gains were slightly lower for the fermented control than the fresh frozen or those with additives included. All feed additive silages had slightly increased feed efficiency over the fermented control, but performance data over such a short period with a few lambs is questionable. SG, SZ, SJ, FC and NH_4OH appeared to increase feed efficiency slightly over the fresh frozen control.

Table 3. Storage changes and stability of corn silage.

Treatment	Losses during storage				
	Time to mold appearance (Days)	Wet matter loss (%)	Dry matter loss (%)	Energy loss (%)	Dig. dry matter change (%)
Fresh frozen control	4	0.0	0.0	0.0	0.0
Fermented control	15	1.3	10.6	8.4	−7.4
SG	9	1.2	11.9	6.6	2.6
SZ	10	1.0	12.6	8.0	0.7
SJ	8	1.0	8.5	4.6	0.0
IV	13	1.1	11.3	10.2	−5.5
SEN	9	0.9	6.6	1.3	3.1
NH_4OH	5	1.0	10.6	4.0	−5.7
FC	7	1.0	8.2	5.5	−0.1

In vitro dry matter digestion suggests SEN and SG increased dry matter digestibility. Fermented corn silage without any additives had the lowest digestibility. Digestible dry matter intake was slightly higher for SEN and fresh frozen control.

In a humidor, ammonia treated and fresh frozen silage spoiled most readily. The silages with the additives added spoiled slightly faster than the fermented control. Wet matter loss during storage was higher for the fermented control suggesting that the additives may have reduced fermentation slightly.

Energy loss during ensiling was higher with IV, SZ and fermented control silages and lower with SEN silage. Dry matter loss during storage was lower with FC, SEN and SJ. Except in one case, energy loss during fermentation was lower than dry matter loss, indicating that energy becomes more concentrated through fermentation. Nevertheless, energy loss through fermentation ranged from 1 to 10 percent of the initial energy content. Besides altering energy loss, additives may influence digestibility of the residue. SG, SZ and SEN appeared to increase total digestible dry matter of forage through fermentation.

These same additives are currently being evaluated with high moisture corn. Further energy retention and digestion trials with several additives for corn silage are planned.