

Evaluation of dry matter intake and weight gain in steers fed diets containing corn silage ensiled with Silaferm. Trenkle, A., P. G. Summer. 2006. Iowa State University.

Abstract

Beef steers weighing 600 pounds were fed corn silage treated or not with Silaferm or mixed with Silaferm at time of feeding in a randomized split-block design to evaluate their feed intake and weight gain during an eighty-eight day feeding trial. Steers consuming silage treated with Silaferm had higher dry matter intake ($P=0.06$) compared with those consuming control silage. Average daily weight gain of steers consuming silage treated with Silaferm was 8.7% higher compared with Control steers but similar to steers consuming silage mixed with Silaferm at time of feeding. Protein efficiency ratio was higher in steers consuming silage treated with Silaferm compared with Silage+Silaferm ($P<0.05$) and tended to be higher compared with Control ($P=0.06$). The results of this trial indicate steers consuming corn silage treated with Silaferm have a higher rate of gain and better protein efficiency compared with untreated silage.

Background

Silaferm is a unique silage additive formulated from downstream processes that result from the production of amino acids. It is high nitrogenous compounds such as ammonium salts, peptides, free amino acids and bacterial proteins. In addition, Silaferm contains organic acids, sugars and betaine.

The mixture of inorganic and organic nitrogen provides a ready source of available nitrogen for microbial growth. Sources of non-protein nitrogen (NPN) such as urea or ammonia have been studied extensively as silage additives. The benefits have included an increase in silage crude protein, increased digestibility in some studies and a general increase in aerobic stability. Ammonium salts have not been studied in detail as corn silage additives. They tend to be acidogenic and might have a different affect upon ensiling compared with alkalogenic NPN sources such as ammonia. Initial laboratory tests indicated that the co-products from amino acid production can improve aerobic stability, increase in vitro digestibility and reduce plant protein proteolysis during ensiling of chopped corn plants.

The objective of this experiment was to determine dry matter intake and growth rate of young steers fed treated silage compared with untreated silage supplemented with soybean meal and control silage with Silaferm added at the time of feeding during a 90 to 100-day growing period.

Silages

Two plastic bags were filled with whole plant corn silage in the Fall of 2006 at the Beef Nutrition Farm. One bag was filled with chopped corn treated with the co-product (Silaferm) and the other with untreated corn chopped at the same time. The co-product was added at the time of filling the bags at the rate of 2.5% of wet forage weight.

Cattle experiment

One hundred twenty preconditioned and weaned steers, predominantly Angus with some red and Charolais cross steers, weighing 575 lbs were purchased in early March 2007. After arrival at the research farm the calves were placed in pens of six animals and fed a diet containing whole plant corn silage, chopped grass hay and supplement. After a few days the diet was changed to whole plant corn silage and supplement. Twenty days after arrival at the feed yard the calves were weighed and sorted into outcome groups for allotment to pens. The steers were allotted from the outcome groups to 20 pens of six steers. Four pens were assigned at random to each of the three silage treatments; 1) control silage, 2) silage treated with Silaferm at the time the bags were filled and 3) control silage fed with Silaferm. The starting weight of each steer was the average of two weights taken early in the morning on two consecutive days prior to feeding but with access to water. The steers were implanted with Component E-S at the start of the experiment.

The steers were fed the diets shown in Table 1. All diets were balanced to have a positive cation-anion ratio. The supplement portion of the diets was prepared as a mix. The supplement, corn silage and Silaferm (treatment 3) were weighed and mixed in a mixer wagon prior to delivery to the cattle. The cattle were fed twice per day and the amount of feed offered the cattle was gradually increased until their appetite was satisfied. Then they were fed according to appetite. If the amount of feed consumed decreased, they were offered less feed and feed that accumulated in the bunks was removed and sampled for determination of dry matter. The supplements and corn silages were periodically sampled for chemical analysis.

The final weight of each steer was the average of two weights taken on consecutive days. Steers were fed 88 days. Average daily gains of each steer were calculated from their beginning and ending weights.

Pen means were used as the experimental unit in the statistical analysis. Data were analyzed by analysis of variance. Differences were considered to be statistically significant at $P < .05$. Treatment means and standard errors of the means are presented.

Table 1. Composition of diets (dry basis).

	Silage treatment		
	Control	Control + Silaferm	Treated with Silaferm
Ingredient composition			
Corn silage	92.48	86.71	92.03
Silaferm		5.325	
Dry rolled corn	1.755	4.700	4.705
Soybean meal	3.25		
Urea	1.31		
Molasses	0.058	0.048	0.048
Limestone	0.608	0.619	0.619
Dicalcium phosphate	0.074	0.078	0.078
Potassium carbonate		1.70	1.70
Sodium bicarbonate		0.396	0.396
Salt	0.30	0.30	0.30
Elemental sulfur	0.042		
Vitamin A premix ^a	0.08	0.08	0.08
Trace mineral premix	0.024	0.024	0.024
Rumensin premix ^b	0.0195	0.0195	0.0195
Chemical composition ^c			
Crude protein	10.79	11.75	10.44
Sodium, % of dry matter	0.28	0.33	0.35
Potassium, % of dry matter	1.03	1.54	1.56
Chlorine, % of dry matter	0.33	0.40	0.46
Sulfur, % of dry matter	0.18	0.39	0.32
milli-Equivalents/kg ^d	180	244	222

^aProvided 1,400 IU of vitamin A activity per pound of dry matter.

^bProvided 15.6 mg sodium monensin per pound of dry matter.

^cAverage of weekly TMR samples; 11 weeks.

^dCalculated as $(Na + K) - (Cl + S)$.

Results and Discussion

The results of the cattle experiment are summarized in Table 2. The steers consuming the Silaferm treated silage gained 8.7% more weight per day compared with those consuming the control diet; however, this difference was not statistically different ($P=0.21$) although it is an economically practical difference. Steers consuming Silaferm treated silage had similar daily weight gains compared with those consuming Control + Silaferm silage. Steers consuming Silaferm treated silage tended to have higher dry matter feed intake ($P = 0.06$) compared with those consuming control silage. Efficiency of gain per pound of feed was similar among all treatments. A sample of each totally mixed ration for each treatment was taken each week during the experiment and analyzed for dry matter, crude protein and mineral content. Table 1 shows the average crude protein content of Control + Silaferm diet was higher than anticipated when the diets were formulated and was 1.0 and 1.3 unit percent higher than Control and Silaferm treated silage diets, respectively. As a result, steers consuming Control + Silaferm had a 10% increase in crude protein ($P < 0.05$) intake compared with steers consuming Control or Silaferm treated silage. The protein efficiency ratio in steers consuming Silaferm treated silage was significantly greater compared with Control + Silaferm and tended to be greater ($P = 0.11$) compared with Control.

In lab scale mini-silo experiments, it has been shown that Silaferm treated corn silage has higher dry matter digestibility and higher true plant protein content compared with untreated control silage. The data in this experiment tend to support these previous results. Steers consuming Silaferm treated silage gained weight more quickly compared with Control steers. The difference was not statistically significant, mostly due large variation in the Control + Silaferm group (raw data not shown). If these replicates are omitted from the data set and Silaferm treated silage steers are compared directly with Control steers, there is a significant difference ($P = 0.03$) in average daily gain. It's unclear why there was so much variation within the Control + Silaferm group. Further, the higher protein efficiency ratio in Silaferm treated silage steers indicates a higher quality protein that could support quicker weight gains. Plant proteins are extensively degraded during the ensiling process, yielding non-protein nitrogen such as ammonium. Reducing plant proteolysis during ensiling increases the value of the crude protein. The higher protein efficiency ratio measured in this trial suggests that Silaferm treated silage had less plant protein proteolysis during ensiling, which agrees with previous lab scale experiments. In addition, steers consumed Silaferm treated silage in amounts that tended

to higher than Control silage steers. The experimental design doesn't allow any conclusions about palatability; however, the data suggest there is nothing inherent in treated silage that would decrease feed intake.

Table 2. Performance of steers consuming corn silage diets.

Item	Treatment			SEM
	Control	Control + Silaferm	Silaferm treated silage	
Beginning wt, lbs	605	603	604	
Ending wt, lbs	834	845	853	7.78
Gain, lbs/d	2.51	2.71	2.73	0.08
Feed intake, lbs DM/d	15.23	15.82	15.97	0.19
Gain/Feed	0.165	0.171	0.171	0.004
Crude Protein intake, lbs/88d	146 ^a	164 ^b	148 ^a	1.87
Protein Efficiency Ratio ^c	1.57 ^a	1.51 ^b	1.69 ^a	0.04

^{ab}Means within rows with unlike superscripts differ, P < 0.05.

^cProtein efficiency ratio = lbs of live-weight gain / lbs of crude protein intake.

Investigators: Allen Trenkle, Dept of Animal Science, atrenkle@iastate.edu Phone: 515-294-4447

Paul Summer, Ajinomoto USA, Inc., Eddyville, IA, summerp@ajiusa.com

Phone: 641-969-4561 x2121