Corn Silage and Earlage Nutrient Analysis

A.S. Leaflet R3218

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Summary and Implications

Corn Silage and earlage are two common feeds for beef cattle. Both of these feeds can increase beef production per acre as compared to corn grain but require good management from production through feeding to optimize beef production. Variation in the production, harvesting and storage of these feeds could influence the nutrient analysis and beef production.

Introduction

Approximately 349,000 acres of corn are harvested as corn silage in Iowa. (USDA Census of Ag 2012-2016) No data are available on number of acres harvested as earlage. A survey of production, harvesting, storage and feeding practices combined with sampling and laboratory analysis of feeds was completed to help characterize production and feeding practices and the nutrient analysis.

Materials and Methods

A survey was developed to gather data from producers who utilized corn silage or earlage. The survey included questions on acres harvested, hybrids used, type of harvesting equipment, estimated yield, storage methods and feeding practices. The survey was mailed to selected producers and made available on-line to complete through the Iowa Beef Center website during the winter of 2017. Ninety six completed surveys were returned. Forty six of the surveys were from producers using silage, 31 were from producers who utilized both corn silage and earlage, and 19 used earlage only.

Sample analysis of corn silage and earlage samples were offered to participating producers. Producers could take samples and send them to the lab or Extension Beef Field Specialist did the sampling. Thirty five silage samples and 20 earlage samples were sent to Dairyland Labs for analysis. Most samples were taken in late Jan through April. Corn silage samples were analyzed using the Near Infared Complete Corn Silage analysis, which includes all nutrient analysis, digestibility analysis, and some fermentation analysis measures. Earlage samples were analyzed using the NIR UW Grain analysis which includes nutrient analysis, fermentation analysis and grain particle size analysis measures.

Twenty seven surveys from producers using corn silage were matched to silage samples and 17 surveys from producers using earlage were matched to earlage samples.

In addition to the laboratory analysis the Penn State Particle Separator was used when possible to evaluate effective particle size, mainly on samples collected by field specialists. Ten silage samples and 17 earlage samples were evaluated using the particle separator.

Results and Discussion

Analysis of corn Silage and earlage samples showed a large variation in most of the traits. Utilizing a book value for the individual samples in formulating a diet would result in feed and nutrient intake calculated errors in most situations. Only 40% of survey respondents tested for moisture content routinely on silage and two-thirds analyzed silage for nutrients and moisture and nutrients for earlage. Analysis averages, minimums, maximums, and standard deviations for a few of the analyzed characteristics are shown in Table 1 and Table 2.

Regressions were run using the sample analysis results to try to identify key factors that can be analyzed and affected by production management that would influence the feed value of the corn silage. The regression coefficients for several factors are shown in Table 3. Acid detergent fiber (ADF), neutral detergent fiber (NDF), non-fibrous carbohydrates (NFC) and starch analysis were the main factors that were analyzed that were highly correlated to net energy NEg. Neutral Detergent Fiber digestibily (NDFD30) measures were not as highly correlated.

Samples were sorted by information provided on the associated survey. Averages by silage variety used or not, storage type or other characteristics did not vary greatly. .

Sample moisture was compared to the target moisture indicated on the survey. Analyzed moisture of silage samples was on average 9.25% percent points different and on earlage samples 6.25% percent points than the targeted moisture indicated on the survey. We did not have actual moisture tests at time of harvest to compare. As in any sampling of high moisture feed, sampling time and method could be a potential source of variation.

The Penn State Particle Separator results are shown in Table 5 for corn silage samples and Table 4 for earlage sample. Again, there was considerable variation among the samples. The targeted cut length stated on the survey was compared to the particle separator data where available. There was a clear trend that with the smaller target cut size, the particle size was smaller.

On the earlage samples, the UW grain evaluation of effective mean particle size had relatively high variation. Smaller effective mean particle size and improved starch digestion has been validated with lactating dairy cows, but is not for use with growing beef cattle at this time. The variation does suggest that this could be evaluated in beef cattle.

For the samples that had associated survey estimates on yield, the corn silage to beef calculator excel spreadsheet was used to calculate beef per acre for corn silage and earlage. Those results ranked in order of beef per acre are in

Tables 6 and 7. Although yield, dry matter, NDF, and NDF digestibility measures are all important it would appear that silage or earlage yield and dry matter influence beef production per acre the greatest in this small sample size. We did not have a means to measure how dry matter affects storage losses but would assume that harvesting at optimum moisture for packing and fermentation would pay benefits.

Table 1. Corn silage sample analysis.

	Average	Maximum	Minimum	Standard Deviation
Dry Matter	43.26%	58.85%	28.65%	8.12%
Crude Protein	6.84%	8.74%	5.47%	0.74%
Adj. Crude Protein	6.72%	8.74%	5.47%	0.73%
Calcium	0.21%	0.36%	0.16%	0.05%
Phosphorus	0.23%	0.27%	0.20%	0.01%
Magnesium	0.14%	0.23%	0.10%	0.03%
Potassium	0.92%	1.38%	0.10%	0.28%
Sulfur	0.13%	0.90%	0.09%	0.16%
Starch	40.50%	48.58%	21.78%	6.22%
Ash	5.19%	7.94%	3.58%	1.02%
Sugar (ESC)	1.17%	8.70%	0.25%	1.67%
NFC	51.75%	62.30%	36.80%	5.26%
Fat (EE)	3.36%	3.93%	2.80%	0.30%
ADF	23.27%	33.57%	19.36%	3.35%
aNDF	34.51%	46.84%	24.29%	4.53%
Lignin	9.61%	20.44%	7.55%	2.45%
NDFD 30	51.79%	60.64%	29.48%	5.58%
uNDFom30	16.19%	22.94%	11.63%	2.67%
pH	4.05	4.52	3.54	0.1988
Lactic Acid	2.74%	5.63%	0.60%	1.09%
Acetic Acid	1.83%	3.37%	0.57%	0.87%
Propionic Acid	0.39%	0.65%	0.21%	0.14%
Silage Acids	4.93%	8.29%	1.71%	1.51%
NEm OARDC	72.55	79.27	0.77	15.32
NEg OARDC	48.17	52.11	38.67	3.52
Nem ADF	75.47	80.01	71.47	1.71
Neg ADF	47.80	51.80	44.26	1.51

Table 2. Earlage sample analysis.

	Average	Maximum	Minimum	Standard Deviation
Dry Matter	66.10%	76.84%	52.82%	6.13%
pH	4.17	4.77	3.44	0.35
Crude Protein	7.86%	8.62%	6.58%	0.60%
Adj. Crude Protein	7.77%	8.62%	6.58%	0.63%
Calcium	0.66%	6.00%	0.04%	1.77%
Phosphorus	0.26%	0.31%	0.23%	0.02%
Magnesium	0.11%	0.13%	0.10%	0.01%
Potassium	0.45%	0.51%	0.40%	0.03%
Starch	60.11%	65.99%	49.61%	3.94%
Ash	1.75%	2.24%	1.48%	0.19%
Sugar (ESC)	1.07%	2.33%	0.15%	0.55%
NFC	72.30%	78.77%	63.29%	4.05%
Fat (EE)	3.55%	4.01%	3.09%	0.25%
ADF	7.61%	12.03%	5.08%	1.83%
aNDF	15.65%	25.13%	9.43%	4.06%
Lactic Acid	1.12%	2.06%	0.41%	0.45%
Acetic Acid	0.50%	1.61%	0.12%	0.36%
NEM Ordac	92.77	95.69	88.85	2.19
NEG Ordac	62.82	65.31	59.47	1.87
Nem ADF	92.04	94.45	88.20	1.72
Neg ADF	62.20	64.26	58.91	1.47
Mean Particle Size MPS	2101.00	2823.00	1630.00	368.37
Effective MPS	711.54	1786.00	0.00	686.50

Table 3. Regression coefficients for corn silage nutrient analysis.

	NDFD 30	DM	pH	ADF	NDF	NDFom	Lignin	Starch	Neg
DM	0.13								
Ph	0.02	0.14							
ADF	0.34	0.45	0.18						
NDF	0.34	0.47	0.13	0.92					
NDFom	0.68	0.37	0.13	0.79	0.85				
Lignin	0.71	0.12	0.03	0.2	0.24	0.49			
Starch	0.39	0.55	0.24	0.87	0.93	0.84	0.27		
Neg	0.33	0.44	0.01	0.88	0.98	0.82	0.23	0.88	
NFC	0.26	0.49	0.28	0.92	0.94	0.76	0.16	0.92	0.88

Table 4. Penn State Particle Separator results for silage samples.

	Average	Maximum	Minimum	Standard Deviation
Top tray	7.78%	15.40%	2.50%	5.21%
Middle tray	54.57%	61.90%	43.59%	6.48%
Bottom tray	37.65%	53.85%	26.50%	9.55%

Table 5. Penn State Particle Separator results for earlage samples.

	Average	Maximum	Minimum	Standard Deviation
Top tray	4.55	10.00	1.34	2.94
Middle tray	23.78	44.16	12.50	10.31
Bottom tray	69.37	85.00	32.50	15.22

Table 6. Pounds of beef per acre of corn silage.

Bu yield	Silage yield ton	Dry matter	%NDF	% NDF digestibility	Beef per acre
247.5	28	58.85	32.51	54.9	3496.4
247.5	28	55.23	32.3	51.85	3208.0
220	21	51.01	30.98	54.44	2320.8
215	23.5	44.52	33.58	53.77	2151.0
228	26	38.99	31.77	56.88	2105.4
225	30	37.27	37.24	55.72	2077.9
225	24	44.30	37.4	54.65	1978.8
197.5	18.5	43.86	31.9	49.23	1876.6
190	18	39.89	31.64	53.8	1519.7
182.5	22	39.76	38.93	50.42	1479.2
197.5	18.5	37.92	36.19	49.97	1422.9

Table 7. Pounds of beef per acre of earlage.

Bu yield	Earlage yield ton	Dry matter	%NDF	% DM digestibility	Beef per acre
75	17.5	52.82	21.53%	82.67%	2961
225	12	76.84	18.55%	84.23%	2953
225	12	68.25	20.41%	82.70%	2623
210	11	66.39	9.43%	87.26%	2343
230	11	61.44	16.30%	84.47%	2166
248.5	8	67.92	12.36%	86.57%	1743

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