Iowa-Wisconsin Silage Conference

June 21, 2018

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Proceedings contents

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June 2018 | AEP 1308

Thursday, June 21, 2018

8:30 AM Registration and refreshments

9:30 AM Welcome and opening comments
Denise Schwab, Extension beef field specialist, Iowa State University Extension and Outreach, Vinton, IA
Mississippi ballroom

9:45 AM Quality corn silage before, during and after harvest
Dr Hugo Ramirez-Ramirez, assistant professor, Animal Science, Iowa State University, Ames, IA
Mississippi ballroom

10:30 AM Characteristics of corn varieties for silage
Dr Randy Shaver, professor, Dairy Science, University of Wisconsin-Madison, Madison, WI
Mississippi ballroom

11:15 AM Molds and mycotoxins in silage
Dr Paige Gott, ruminant technical manager, Biomin, Overland Park, KS
Mississippi ballroom

12:00 PM Lunch (provided)
Atrium

1:00 PM Pricing corn silage
Denise Schwab, Extension beef field specialist, Iowa State University Extension and Outreach, Vinton, IA; Bill Halfman, Agriculture Agent - Monroe County, University of Wisconsin-Extension
Mississippi ballroom

Concurrent session A (select one)

1:30 PM Corn silage in dairy rations
Dr Hugo Ramirez-Ramirez, assistant professor, Animal Science, Iowa State University, Ames, IA
Mississippi ballroom

Corn silage in beef finishing rations
Dr Galen Erickson, professor, Ruminant Nutrition and Nebraska Cattle Industry Professor of Animal Science, University of Nebraska-Lincoln, Lincoln, NE
Mississippi D

Concurrent session B (select one)

2:00 PM Silage and beef calculators
Dr Garland Dahlke, assistant scientist, Animal Science, Iowa State University, Ames, IA
Mississippi D

Update on contemporary corn silage processing
Dr Randy Shaver, professor, Dairy Science, University of Wisconsin-Madison, Madison, WI
Mississippi ballroom

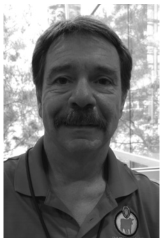
2:30 PM Break

Closing session

2:45 PM Machinery efficiency
Dr Brian Luck, assistant professor and extension specialist, Biological Systems Engineering, University of Wisconsin-Madison, Madison, WI
Mississippi ballroom

3:15 PM Corn silage safety
Dr Keith Bolsen, , Keith Bolsen Silage Safety Foundation, Austin, TX
Mississippi ballroom

3:45 PM Closing comments and adjourn
Mississippi ballroom



Randy Shaver

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Characteristics of corn hybrids for silage

Objectives

- Understand key corn silage quality indicators
- Understand how hybrid type influences NDF and starch digestibility
- Update on latest corn hybrids available for silage production

Modern high-quality corn silages contain 36%-41% NDF and 32%-39% starch (DM basis) with 54%-60% 30-hr in vitro NDF digestibility (ivNDFD; % of NDF). Corn hybrid impacts grain yield, and thus potential starch content of corn silage through an increased grain:stover ratio. But, actual starch content is largely uncontrolled and varies widely (normal range of 25% to 39%) depending on crop growing conditions, harvest timing relative to kernel maturity, and cutting height. Because of extensive variation in grain and starch contents in whole-plant silage and corresponding dilution effects on other nutrients, i.e. NDF and its constituents or digestion fractions, comparisons done across samples for lignin and uNDF240 should be done on an NDF basis rather than on a DM basis. It appears that only BMR-type (reduced lignin) hybrids offer consistent and major improvements in ivNDFD. Controlled lactation performance data is available only for bm3 mutant BMR hybrids, and only limited comparative data could be found for lignin, ivNDFD and yield with bm3 vs. bm1 mutant BMR hybrids. Future industry directions with bm3 vs. bm1 mutant BMR hybrids appear uncertain at this time. Although the fundamental research base on corn kernel endosperm properties is solid, development of corn hybrids with a less-vitreous endosperm than normal to improve starch digestibility of corn silage, has not emerged broadly across the seed corn industry likely for the following reasons which temper potential genetic effects: harvest should be completed prior to the black layer stage of kernel maturity, kernels should be well-processed during harvest, and prolonged silo storage enhances starch digestibility. Furthermore, there is no standardized, agreed upon laboratory method to assess starch digestibility differences among corn silage hybrids upon which to base hybrid comparisons or selection. Another concern is that a selection index based on starch digestibility could adversely impact future yield and (or) ivNDFD gains in corn silage hybrids. A few "seed to cow" focused companies, however, have pursued starch digestibility in their hybrid line-ups. The starch digestibility focus has also emerged in a few of the latest corn silage hybrids being marketed to dairy farmers, which include floury-leafy, floury bm3, and high-amylase corn hybrids. Controlled production, intake, and digestion experiments in lactating dairy cows, however, are very limited for these corn hybrids. Potential animal performance benefits need to be weighed against any potential yield drag and (or) seed/trait cost increases. AS mentioned, any ivNDFD differences in these hybrids needs to evaluated and taken into account.

Resources

R.D. Shaver website
shaverlab.dysci.wisc.edu

UWEX Team Forage website
fyi.uwex.edu/forage

Hugo Ramirez Ramirez

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Quality corn silage before, during and after harvest

Objectives

- Understand the nutritional value of corn silage and how it benefits the animal
- Understand how different factors can affect corn silage quality at different stages
- Review animal responses to improved forage quality

Feed accounts for the largest cost of production in most livestock operations and many beef and dairy cattle producers are constantly looking for economic and effective ways to feed their livestock. Including more forage can lower the cost of a ration *as long as it is high quality!* Corn silage is unique in that it contains both grain and forage. This combination provides animals with dense energy in kernels and rumen-stimulating fiber from leaves, stalk, and husk. This forage is a remarkable feedstuff not only in dairy rations but it can be a great asset in beef operations as well. Corn silage can be fed as supplemental forage on pasture or confinement and is a key source of energy and roughage for feedlot cattle.

What affects quality of corn silage?

Producing high quality corn silage is a labor-intensive and fast-paced operation. The entire process starts with selection of an appropriate hybrid, it continues in the field when seeds are planted, and is finished when the silage is packed and ***covered!*** Corn silage quality is determined by proper planting and agricultural practices through the growing phase, and proper harvest and feed-out management. During the growing phase, some producers have little to no control of precipitation and other climatic conditions that impact plant development. On the other hand, harvesting is one of the most impactful times to make a difference on quality because producers or operators can have a high level of control. Once the plants reach the desired growth stage, it is critical to maximize the nutrient value so that they can be utilized by the animals. The following are key aspects in producing high quality corn silage:

1. Moisture content is crucial to determine the proper time to harvest corn silage. Proper moisture content allows for good compaction and provides an optimal environment for bacteria to ferment sugars and produce desirable acids. The range in moisture typically oscillates between 60 to 70% with an optimal average of 65%. Too wet corn silage (more than 70% moisture) can result in seepage and development of undesirable bacteria, such as *Clostridium*, which will increase dry matter loss and decrease palatability. On the other hand, if the material is too dry (less 60% moisture), it is hard to pack and exclude air out of the ensiling material. This can result in low density and high spoilage due to respiration, and growth of yeast and molds. Dry matter and visible milk line are used as indicators of corn silage maturity. It can be expected that corn plants will dry down 1 to 0.5 percentage point each day, allowing producers to estimate the right time to harvest. Corn plant maturity and drying down is related to the deposition of starch in the kernel, or formation of the milk line. The milk line should be between two-thirds and three-quarters of the kernel for optimal starch deposition, and starch content can increase almost one percentage point a day!

2. The theoretical length of cut (TLC) for processed corn silage is 3/4" or the width of a penny; if the forage is not processed then the TLC should be 1/4 to 1/2". If chop length is too coarse, it becomes difficult to pack and there could be problems due to spoilage and poor fermentation. Correct particle size can also drive feed intake and rumen fermentation. This can be double-checked using a particle size separator also known as a "shaker box".

3. Kernel processing literally unlocks the energetic potential of the starch contained in the corn kernels. Properly processed corn silage should have no whole kernels and no pieces of cob should be visible. Even though a sample of corn silage may contain significant starch, digestibility of starch may differ because the outer layer of the kernels is not processed and rumen microbes have limited access to ferment the starch. The combination of crushing (1 to 3 millimeter roller gap) and shearing action through differential speed help break kernels apart. Even though kernel processing score can be determined by a forage lab (score less than 50 is inadequate, 50-70 adequate, more than 70 ideal) it does not allow for immediate decisions during the harvesting process. Therefore, it is HIGHGLY recommended to monitor processing during harvest to be able to make adjustments "on the fly". This can be tested using the 32-oz cup method (less than 2 full or partially damaged kernels per cup is desired).

4. Tight packing and complete sealing allows oxygen removal which is essential for growth of anaerobic lactic acid bacteria. These bacteria are responsible for converting sugars into lactic acid, preserving the silage. It is recommended to calculate the capacity for packing prior to harvesting to ensure that enough weight is available and that fresh forage is delivered at the appropriate rate to achieve desired density. Target density at 15 lbs DM/ cu ft or more; researchers at the University of Wisconsin-Madison have developed a spreadsheet calculator to estimate silage density, which is available online.

Figure 1. Packing corn silage in a lined bunker

5. Proper sealing of silage using an oxygen barrier film and black and white plastic will decrease loss of dry matter and nutrients. Lining bunkers prior to filling is another way to prevent spoilage around edges of the bunker. Additionally, weight is needed to keep the plastic covers down and prevent infiltration of air, tires on top of the plastic cover are the most common method. Using sidewalls or perforated tires reduces risk of water accumulation (breeding grounds for mosquitoes). This is a labor-intensive task but the benefits are much greater because well-preserved silage means greater recovery of dry matter, less nutrient loss, and overall better feed. The ideal silage should be covered with tires touching each other. Big or small piles, IT IS POSSIBLE!

Figure 2. Large bunker pile well covered with plastic and tires

Figure 3. General phases of a silage production program for livestock

Producers should consider having a defined "Forage Program" that may encompass the phases depicted in Figure 3. The time, money and effort invested in a high-quality process can pay big dividends as the results represent the base for future feed. Therefore, it is important to make every effort possible to harvest, store and feed high quality forage.

A forage program should consider the following guidelines:

- Grow forages to optimize yield
- Harvest nutrients at an optimal stage for digestion
- Promote efficient utilization of the harvested nutrients

Resources

Iowa State University Dairy Team
www.extension.iastate.edu/dairyteam

ISU Dairy Team Twitter
twitter.com/isudairyteam

ISU Dairy Team Facebook
www.facebook.com/ISUDairyTeam

Paige Gott

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Molds and mycotoxins in silage

Objectives

- Review the factors influencing mold growth and mycotoxin production
- Identify molds and mycotoxins associated with ensiled feeds
- Understand the effects of mycotoxins and potential clinical signs of mycotoxicoses in cattle

Many molds are capable of contaminating crops and feedstuffs, but relatively few are known to produce secondary metabolites called mycotoxins that can negatively impact animal health and performance. Mycotoxigenic molds are categorized based on where they primarily produce mycotoxins: in the ***field* pre-harvest** or in ***storage* post-harvest**. Three key genera are associated with mycotoxin production including *Fusarium* (field) as well as *Aspergillus* and *Penicillium* (storage).

Over 400 mycotoxins have been identified, but relatively few are well-understood when it comes to their potential negative effects in cattle. Some of the most studied and frequently detected mycotoxins include aflatoxins, deoxynivalenol (DON aka "vomitoxin"), and zearalenone. Global concerns regarding the impact of mycotoxins on human and animal health have focused primarily on understanding mycotoxin challenges in cereals and foods relevant to human nutrition. However, many of those mycotoxins are also found in forages. Unique features of ensiled feeds (i.e., high moisture content) can result in complex mycotoxin profiles beyond what are found in other commodities.

Many factors influence mold growth and mycotoxin formation including temperature, moisture content, oxygen levels, pH, substrate, and other stressors like physical damage to the crop. Complete prevention of contamination is difficult, especially since some key factors like weather conditions are beyond human control. Many mycotoxins originate prior to harvest and persist through feedout. Poor silage management including improper moisture content at harvest, inadequate packing density, and poor feedout practices increase the risk of storage molds and mycotoxins. Aerobic instability creates an environment suitable for mold growth. Increased levels of oxygen, whether due to poor compaction, exposure from poor sealing of the silo, or inefficient feedout, support storage mold growth and further contamination.

Molds that are able to grow in environments with low pH and limited oxygen are of concern in silages. *Penicillium roqueforti* is one such mold that can produce a variety of mycotoxins including citrinin, ochratoxin A (OTA), patulin, roquefortine C, PR toxin, mycophenolic acid, and penicillic acid. Another silage-associated mold is *Aspergillus fumigatus* which produces gliotoxin. Most commercial laboratories do not routinely screen feeds for most storage toxins. Therefore, the occurrence of silage-associated mycotoxins have not been well described.

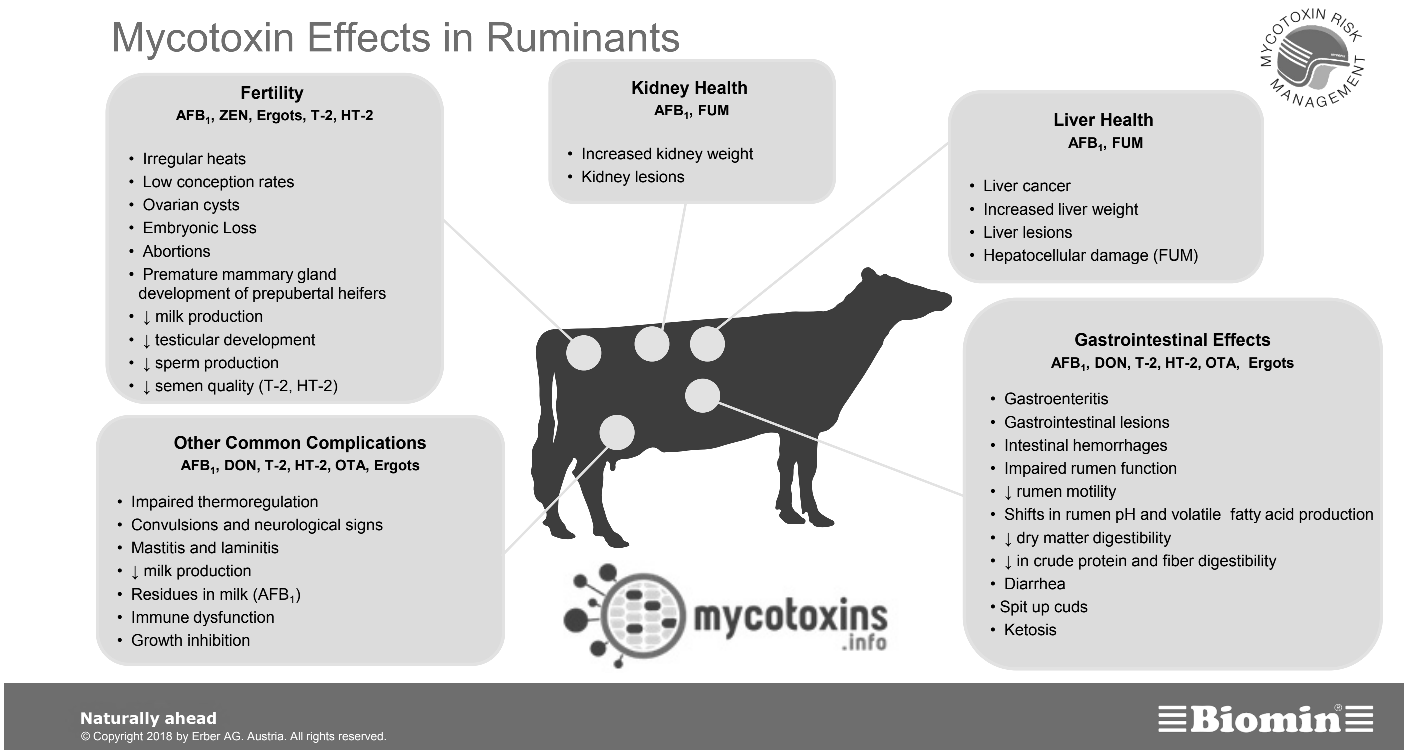
Visible mold growth on feed does not guarantee the presence of mycotoxins, but it does indicate increased risk for contamination and can also reduce feed quality and palatability even if toxins do not exist. Visual inspection may miss mold growth since it is often very uneven and not exposed. Mycotoxins may also be present from the original forage material in the field and with little or no visual signs of contamination.

Although ruminants are thought to be less sensitive to mycotoxins than monogastrics due to potential detoxification by rumen microbes, there is evidence that this natural protection can be impacted by diet, limited by increased passage rate in high-producing cows and can be negatively impacted during sub-optimal rumen function. Furthermore some mycotoxins are evidently little-affected by rumen processes.

Mycotoxins result in a variety of negative effects when ingested (Figure 1). In general, many mycotoxins can cause immune dysfunction, resulting in an increased risk of disease. The effects of most silage-associated toxins have not been studied extensively, but many are thought to suppress immune function and negatively impact rumen microflora. Some have neurologic effects including muscle weakness and others are known to damage organs such as the liver and kidneys. Further research is needed to better understand the impact mycotoxins have on ruminants, especially those originating in ensiled feeds.

Take home points

- Many factors, both pre- and post-harvest, influence mold growth and mycotoxin production.
- Proper silage management from harvest through feeding out is key to help limit storage molds and mycotoxins.
- Best management practices cannot guarantee prevention of mycotoxin development. Therefore, a comprehensive mycotoxin risk management program is essential to limit risk in herds.



AFB1 – Aflatoxin B1 | AFM1 – Aflatoxin M1 | DON – Deoxynivalenol | FUM – Fumonisins | OTA – Ochratoxin A | T-2 – T-2 Toxin | HT-2 – HT-2 Toxin | ZEN – Zearalenone | Ergots – Ergot Alkaloids

Figure 1. Effects of mycotoxins in ruminants.

Resources

Source for mycotoxin information
www.mycotoxins.info

BIOMIN Mycotoxins Blog
www.biomin.net/en/mycotoxins-blog

Review on mycotoxin issues in ruminants: Occurrence in forages, effects of mycotoxin ingestion on health status and animal performance and practical strategies to counteract their negative effects.
Gallo, A., Giuberti, G., Frisvald, J.C., Bertuzzi, T. and Nielsen, K.F. 2015. Toxins, 7, 3057-3111. doi:10.3390/toxins7083957

Occurrence, prevention, and remediation of toxigenic fungi and mycotoxins in silage: A review
Wambacq, E., Vanhoutte, I., Audenaert, K., De Gelder, L., and Haesaert, G. 2016. J. Sci. Food Agric. 96, 2284-2302. Doi:10.1002/jsfa.7565

Hugo Ramirez

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Corn silage in dairy rations

Objectives

- Understand the nutritional value of corn silage for dairy cows
- Gain insight on how different management factors affect silage quality and animal performance
- Review resources for decision making regarding forage quality

Making corn silage is one of the most labor intensive and fast-paced operations on a dairy farm. It takes place during a short time, and it represents the base for future feed for the cows until the next year. Therefore, it is important to make every possible effort to harvest, store, and eventually feed high quality feed. This presentation will review some of the most cost-effective practices to improve or preserve corn silage quality. As seen in the chart below, dairy producers heavily rely on this forage, and it is the base of almost all nutrition programs for dairy cows. In fact, 100% of the surveyed producers include this feed in lactating cow rations.

Even though making corn silage is a staple practice in almost all dairy farms, the variability in weather, harvesting, and management, warrant review of the principles and advancements in forage quality. Below are some of the most common and important aspects to consider when making corn silage for dairy cows:

Hybrid selection

- Forage hybrids, dual purpose hybrids, specialty hybrids

Harvest practices

- Moisture content at harvest
- Processing and no processing
- Inoculants and mold inhibitors
- Plastic covers

Hybrid selection

There are many hybrids on the market with different traits and agronomic characteristics suitable for different geographical areas and intended utilization. For example, having a dual-purpose hybrid offers the possibility of harvesting for silage or for grain, whereas forage hybrid would only be suitable for silage. One the most common and effective traits in corn for dairy cows is the brown mid-rib (BMR) mutation. This is a naturally occurring genetic modification that causes the corn plant to produce less lignin, which is the indigestible component of the plant cell wall. Although variable results can be found, a thorough meta-analysis strongly concluded that feeding BMR will likely result in increased dry matter intake and increased milk yield.

Harvest and post-harvest practices

Processing

One of the most valuable components in corn silage is the starch granules contained within the kernel. In order for starch to be fermented, it is necessary to break the protective layer surrounding the kernel. This layer is called the pericarp. When a dairy cow consumes corn kernels that are properly fragmented, the microbes in her rumen ferment the starch and release energy that the dairy cow can then use for biological processes, including milk synthesis. Figure 2 depicts the productive advantage of using a kernel processor to expose more starch to microbial fermentation.

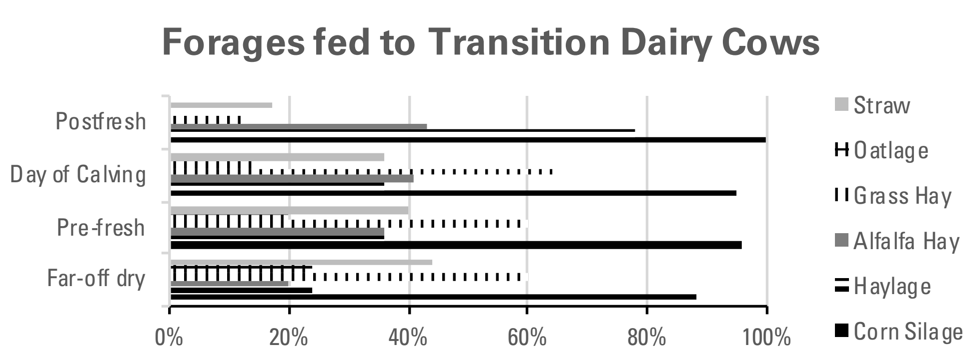

Figure 1. Survey of forages fed to transition dairy cows in Iowa. *Source: Iowa State Extension and Outreach – Dairy Team Producer Survey (2015)*

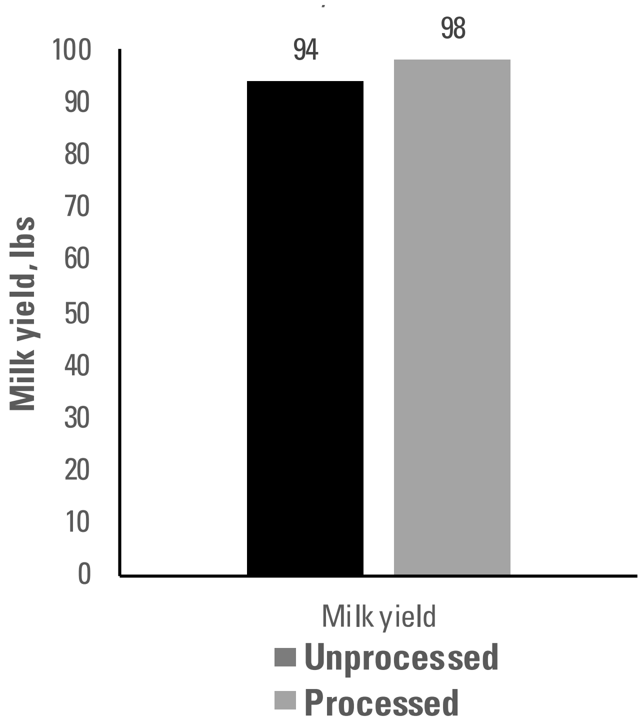

Figure 2. Effects of kernel processing on milk production. *Adapted from Ebling and Kung (2004); P < 0.05.*

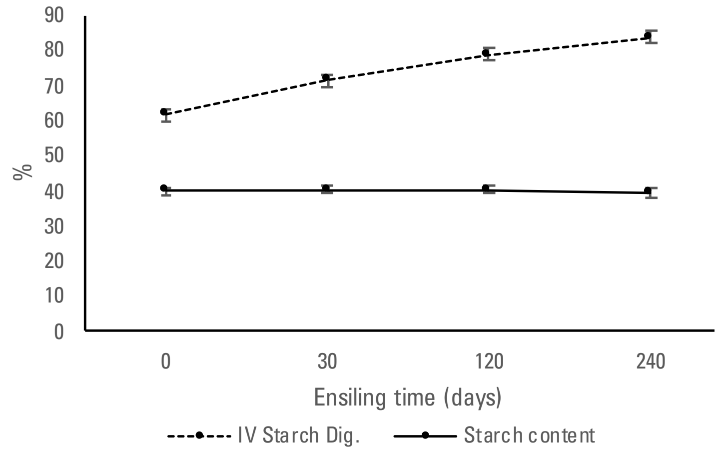

Figure 3. Starch content and in vitro starch digestibility of corn silage over time. *Adapted from Ferraretto et al. (2015)*

Covering

The last step of the silage making process involves covering the forage mass with plastic and tires to preserve the anaerobic environment as much as possible. It is important to mention that not all cover plastics are the same, especially when dealing with oxygen barrier (OB) films. These films are especially engineered to be "impermeable to oxygen". The use of oxygen barrier films can drastically reduce the amount of forage that spoils in the top 3 feet of a silage pile or bunker, which translates in greater dry matter recovery and overall improved quality. The effectiveness of oxygen barriers is determined by an industrial laboratory test that measures oxygen transmission rate (OTR), the lower the value, the more impermeable it is to oxygen. Advantage of OB are not limited to enhancement of anaerobic environment in the top region of a silage pile; once the silage is open, data show that silage that was covered with OB had improved aerobic stability. This translates to less degradation or heating of the silage during the feed-out phase!

Monitoring starch digestibility

The number and the degree of maturity of the kernels in the corn ear determine the starch content of silage. This level remains practically unchanged from the moment of harvest through fermentation and feed out. However, changes do occur over time during fermentation, such that starch becomes more digestible over time. This is because starch is arranged in granules surrounded by proteins that degrade over time during fermentation and storage of corn silage.

After 6 to 8 months of ensiling (Figure 3), the starch is more readily available for microbial fermentation in the rumen. In vitro studies show a difference of almost 20 percentage units in ruminal starch digestibility after 8 months of fermentation; this translates to more energy for microbes and for the cow. Although greater starch digestibility is generally a good thing from a feed quality standpoint, too much starch being degraded in the rumen can also be a negative factor that can depress fiber digestibility and milk fat synthesis! After 6 to 8 months, producers should test corn silage for in-vitro starch digestibility and work with their nutritionist to re-balance the diet and account for the increased starch digestibility. This can translate into better rumen health and even economic savings by using feedstuffs more efficiently!

Dairy producers have many options to grow and harvest corn for silage, and since most dairy farms depend on corn silage to feed the entire herd (except for young calves), it is important to consider the different factors that impact corn silage quality, from hybrid selection to delivery at the feed bunk. In many cases, producers and nutritionists will find one or two aspects that can be improved to enhance forage quality, and most often than not, dairy performance will reflect the quality of the feed!

Resources

Iowa State University Dairy Team
www.extension.iastate.edu/dairyteam

ISU Dairy Team Twitter
twitter.com/isudairyteam

ISU Dairy Team Facebook
www.facebook.com/ISUDairyTeam

Galen Erickson

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Corn silage for beef cattle

Objectives

- Understand impact of increasing corn silage inclusion on performance and economics
- Learn the impact of kernel processing and different hybrids on performance
- Understand the importance of rumen undegradable protein supplementation on performance of growing programs with corn silage
- Learn about the impact of silage DM at harvest on performance

Introduction

Feeding corn silage is not a new concept for finishing beef cattle. Most feedyards process corn silage and feed at low inclusions for roughage. In general, corn silage contains 50% forage and 50% grain and is commonly added at 5 to 15% of diet DM in finishing diets. Please note that all proportions discussed in this paper are inclusions on a DM basis in diets.

Inclusion

We have conducted numerous experiments in the past 7 years evaluating elevated amounts of silage for finishing cattle. In 5 experiments that compared 15% inclusion to 45% inclusion for finishing cattle, ADG decreased by 5.2% or 0.2 lb/d (Table 1). Feed conversion is consistently poorer with F:G being 6.7% greater for cattle fed 45% silage compared to 15%. Corn silage, if priced correctly, is likely one of the lowest costs per unit of energy. Economics depend on accurately pricing with fall corn price, valuing manure nutrients if charged nutrient removal, and managing shrink. Despite being economical, no producers have adopted this practice of elevating silage inclusions. Many feedyards are open to growing cattle for a period prior to finishing. We tested feeding 45% corn silage (on average) by feeding 75% silage for the first half of the feeding period and 15% silage for the second half of finishing, compared to feeding either 15% or 45% silage continuously over the whole feeding period (Ovinge et al., 2018 Midwest ASAS abstract). In past studies, cattle fed 45% silage were consistently less fat than cattle fed 15% silage. Therefore, ultrasound was used and we attempted to slaughter cattle at equal fatness by feeding cattle on the treatments with elevated silage 28 days longer. Cattle fed 75/15 or 45% silage had similar intake, ADG, and F:G to one another (Table 2). However, both treatments resulted in lower ADG and poorer (i.e., greater) F:G than cattle fed 15% silage. Because cattle fed 75/15 or 45% silage continuously were fed 28 days longer to get to similar fatness, HCW was greater for those treatments.

Brown midrib corn silage

If cattle are going to be fed 45% silage in feedlot diets, other technologies may be beneficial if fiber digestion can be improved. One example would be use of brown midrib corn silage hybrids. Hilscher et al. (2018a) evaluated feeding a brown midrib hybrid or a brown midrib with a softer endosperm compared to a control hybrid on performance. At 45% inclusion, feeding either brown midrib hybrid increased gain compared to the control hybrid with variable impacts on F:G. In a growing study, the response to brown midrib hybrids improving performance was different than what was observed in the finishing trial. Cattle fed either brown midrib hybrid had dramatically greater intakes compared to a control hybrid. As a result of a 3 lb greater daily DMI, ADG was increased by 0.6 lb/d but no differences were observed in F:G across the 3 silage hybrid treatments. Feeding brown midrib silage in growing diets with 80% silage inclusion increases fiber digestion which increases passage, increases DMI, increases ADG, but does not impact F:G.

Kernel processing

A typical energy response was observed for kernel processing whereby ADG was not impacted by kernel processing silage and feeding it at 40% inclusion. However, steers fed silage that was kernel processed ate less feed to get the same ADG, resulting in a 2.9% improvement in F:G (Table 3). These data suggest that kernel processing of silage is worth about 7.25% improvement in F:G assuming the entire change in F:G is due to improving the silage fed at 40% of the diet (2.9%/0.4). A recent growing silage study that evaluated kernel processing with silage inclusion of 80% of diet DM suggests a 6.6% improvement in the silage due to kernel processing (data not available yet).

Conclusion

If corn silage is priced correctly, then feeding 2 or 3 times more silage to finishing cattle than typical will result in poorer feed conversion by about 5%. This is dependent on silage hybrids and kernel processing. If more silage is going to be used during finishing, having sufficient bypass protein from distillers grains is important. Most of these studies used 20% or more distillers grains on a DM basis. If producers don't want to use 45% silage, but want to grow cattle on high-silage diets and step them down halfway through, then performance is the same as if feeding 45% silage continuously.

Resources

UNL Beef Cattle Production
beef.unl.edu

Table 1. Effect of 15% or 45% corn silage (DM basis) on performance and carcass characteristics across 5 experiments.

	Treatment[1]		
Item	**15**	**45**	***P*-value**
Pens, n	58	58	
Performance			
DMI, lb/day	24.5	24.9	0.17
ADG, lb[2]	3.86	3.66	<0.01
Feed:Gain[2]	6.29	6.71	<0.01

[1] Across 5 experiments, 22 pens of yearlings, 36 pens of calf-feds. Diets fed with either 20 or 40% distillers grains.

[2] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

Table 2. Effect of growing cattle on corn silage at 75% followed by 15% compared to cattle fed 15% or 45% continuously, with cattle fed elevated silage longer to equal fatness (Ovinge et al., 2018a Midwest ASAS abstract).

	Treatment[1]			
Item	**15**	**45**	**75/15**	***P*-value[2]**
DOF, d	153	181	181	
Performance				
DMI, lb/day	23.7	23.6	23.0	0.09
ADG, lb[3]	4.02[a]	3.82[b]	3.73[b]	<0.01
Feed:Gain[3]	5.88[a]	6.18[b]	6.17[b]	<0.01

[a,b] Means with different superscripts differ ($P < 0.05$).
[1] Treatments were 15% silage inclusion, 45% silage inclusion, and 75 to 15% silage inclusion
[2] P-value for the main effect of corn silage inclusion
[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

Table 3. Main effect of kernel processing of corn silage when fed at 40% of diet DM on growth performance and carcass characteristics (Ovinge et al., 2018b beef report)

	Treatment[1]			
Item	**–KP**	**+KP**	**SEM**	***P*-value[2]**
Pens, n	18	18		
DMI, lb/day	32.6	31.8	0.27	0.04
ADG, lb[3]	4.38	4.38	0.047	0.93
Feed:Gain[3]	7.45	7.24	–	0.10

[1] Treatments were not kernel processed (-KP) or kernel processed (+KP)
[2] P-Value for the main effect of kernel processing
[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

Sources

Burken, D. B., B. L. Nuttelman, M. J. Jolly-Briethaupt, J. L. Harding, S. E. Gardine, T. J. Klopfenstein, J. C. MacDonald, and G. E. Erickson. 2017. Digestibility and performance of steers fed varying inclusions of corn silage and modified distillers grains with solubles to partially replace corn in finishing diets. Transl. Anim. Sci. 1:382-396. doi:10.2527/tas2017.0046

Burken, D. B., B. L. Nuttelman, J. L. Harding, A. L. McGee, K. M. Sudbeck, S. E. Gardine, T. C. Hoegemeyer, T. J. Klopfenstein, and G. E. Erickson. 2017. Effects of agronomic factors on yield and quality of whole corn plants and the impact of feeding high concentrations of corn silage in diets containing distillers grains to finishing cattle. Transl. Anim. Sci. 1:367-381 doi:10.2527/tas.2017.0045

Hilscher, F. H., C. J. Bittner, J. N. Anderson, and G. E. Erickson. 2018. Evaluation of brown midrib corn silage for growing and backgrounding beef steers. Neb Beef Cattle Rep. MP105:47-48.

Hilscher, F. H., M. L. Jolly-Breithaupt, J. L. Gramkow, H. C. Wilson, M. M. Norman, J. N. Anderson, and G. E. Erickson. 2018. Nutrient digestibility and fermentation of brown midrib corn fed to growing beef steers. Neb Beef Cattle Rep. MP105:49-51.

Hilscher, F. H., C. J. Bittner, J. N. Anderson, and G. E. Erickson. 2018. Evaluation of corn silage hybrids with the brown midrib trait and silage inclusion for finishing cattle. Neb Beef Cattle Rep. MP105:86-88.

Ovinge, L. A., F. H. Hilscher, C. J. Bittner, B. M. Boyd, J. N. Anderson, and G. E. Erickson. 2018. Effects of kernel processing at harvest of brown midrib corn silage on finishing performance of steers. Neb Beef Cattle Rep. MP105:89-91.

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Evaluating corn silage for beef

Objectives

- The concept involved in evaluating silage for beef rations
- The nutrients that must be obtained from a lab analysis to make this work
- Exposure to the Corn Silage to Beef tool, obtaining it and making it work

Resurgence in the use of corn silage for beef rations is currently under way in the upper Midwest. Improvements in harvesting equipment, corn silage quality traits, yield per acre and the need for fiber in beef cattle rations are some of the reasons driving this interest. Sorting through the varieties of corn used for silage however becomes daunting if one is to provide guidance in terms of variety selection or ranking when trying to determine the most appropriate varieties to grow for silage for beef cattle. Grain yield per acre generally has been the driving force when looking at the variety selection for beef feed, but with the wide spread availability of varieties with improved digestibility and the use of silage for beef cattle outside of a feedlot the value of the fiber in terms of providing energy should be considered.

The dairy industry has already initiated a Milk 2006 evaluation that involves the inclusion of fiber digestibility in the evaluation of the silage and presents results in terms of milk per acre. The beef industry can do the same, but in this case it would be in terms of beef produced per acre. The slower passage rate of feed through beef animals, as compared to a dairy cow, lends well to the 48 hour NDFd analysis. The potential of two extremely different rumen environments that exist in beef production however also needs to be addressed. The feedlot animal being a fed a high energy ration containing high levels of starch tends to severely impede fiber digestion due to the subsequent reduction in rumen pH. An indication that this type of diet is being fed will decrease the NDFd value reported by the laboratory by 70% in this proposed model. The stock cow, growing calf and developing replacement animal maintain a fiber digestive capacity equal to or exceeding that found in the dairy cow and gives full credit to the NDFd analysis value.

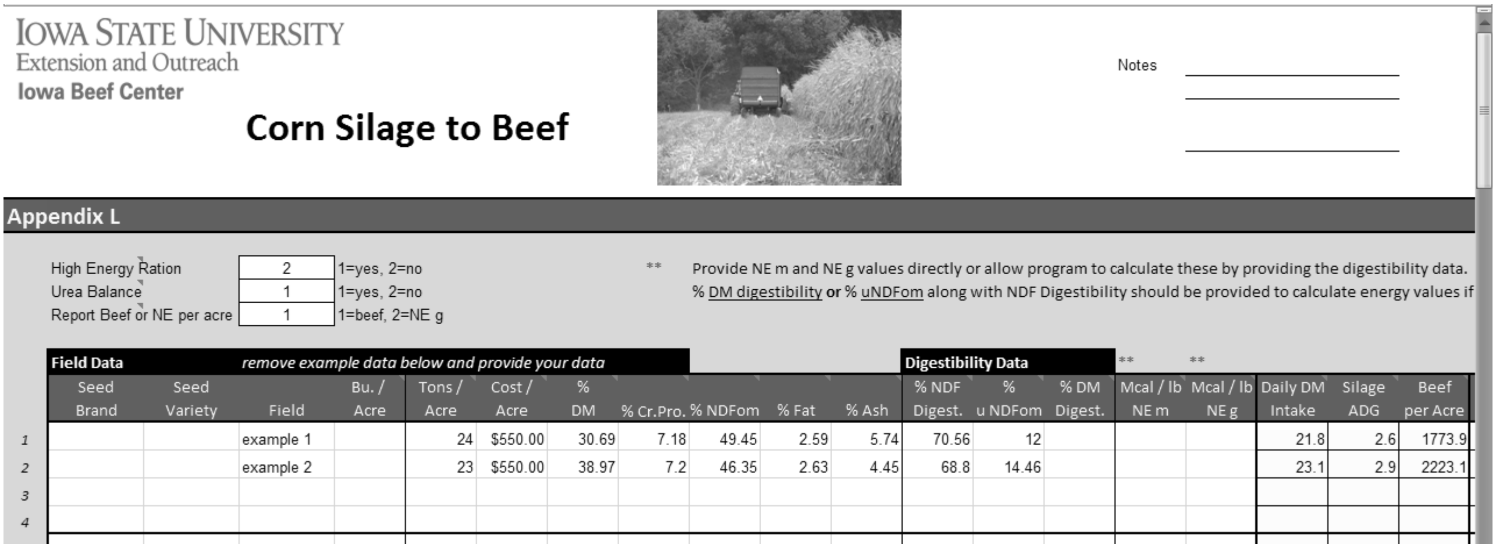
Another point of interest in corn silage is that of crude protein content. Although one generally considers feeding corn silage as a source of energy, the contribution of the protein from this feed probably should not be overlooked. We may see samples from 5% to over 10% crude protein. Although this may not be a great concentration when compared to other forages, it is quite substantial when considering one variety may have about twice the protein of another and that this protein does matter in terms of diet supplementation. To address this dilemma options to include an equivalent quantity of urea can be applied allowing the varieties to be compared in terms of energy provision if one chooses to do so. This adaptation comes with a supplement cost based on the feed grade commodity price that is factored into the cost of producing the crop and the crop yield.

Resources

Iowa Beef Center calculators
www.iowabeefcenter.org/calculators.html

Iowa Beef Center BRaNDS
store.extension.iastate.edu/product/967

Details to the calculation will be published in the 2019 ISU Animal Industry Report
lib.dr.iastate.edu/ans_air



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Iowa Beef Center

Corn Silage to Beef

Notes

Appendix L

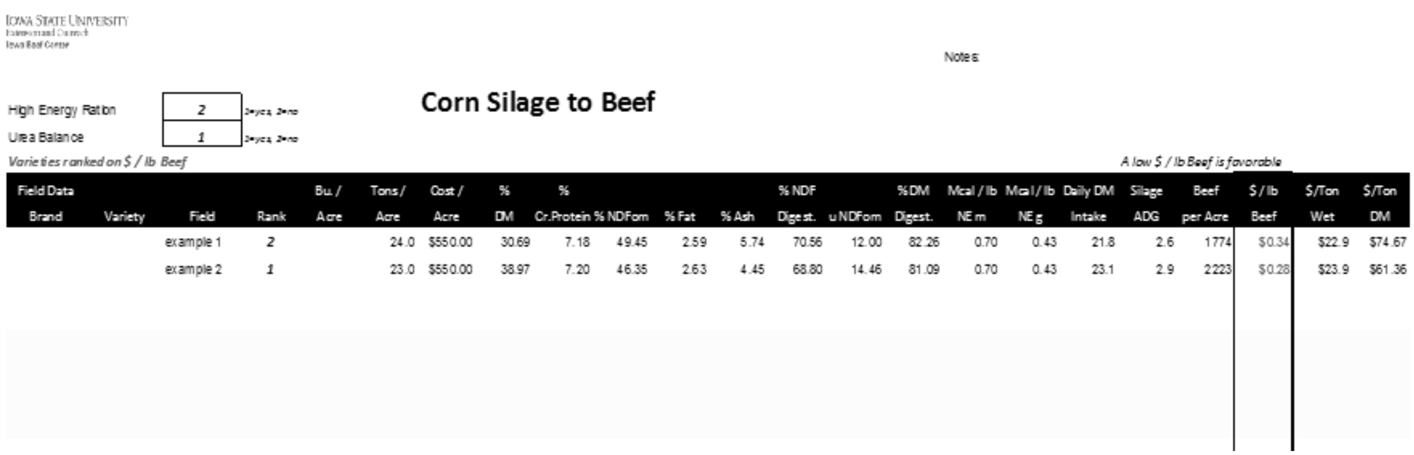
High Energy Ration	2	1=yes, 2=no
Urea Balance	1	1=yes, 2=no
Report Beef or NE per acre	1	1=beef, 2=NE g

** Provide NE m and NE g values directly or allow program to calculate these by providing the digestibility data. % DM digestibility **or** % uNDFom along with NDF Digestibility should be provided to calculate energy values if

Field Data *remove example data below and provide your data* **Digestibility Data** ** **

	Seed Brand	Seed Variety	Field	Bu. / Acre	Tons / Acre	Cost / Acre	% DM	% Cr.Pro.	% NDFom	% Fat	% Ash	% NDF Digest.	% u NDFom	% DM Digest.	Mcal / lb NE m	Mcal / lb NE g	Daily DM Intake	Silage ADG	Beef per Acre
1			example 1		24	$550.00	30.69	7.18	49.45	2.59	5.74	70.56	12				21.8	2.6	1773.9
2			example 2		23	$550.00	38.97	7.2	46.35	2.63	4.45	68.8	14.46				23.1	2.9	2223.1
3																			
4																			

Figure 1. Screen shot of the user interface for the Silage to Beef Calculator



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Notes:

Corn Silage to Beef

High Energy Ration	2	1=yes, 2=no
Urea Balance	1	1=yes, 2=no

Varieties ranked on $ / lb Beef

A low $ / lb Beef is favorable

Field Data Brand	Variety	Field	Rank	Bu. / Acre	Tons / Acre	Cost / Acre	% DM	% Cr.Protein	% NDFom	% Fat	% Ash	% NDF Digest.	u NDFom	% DM Digest.	Mcal / lb NE m	Mcal / lb NE g	Daily DM Intake	Silage ADG	Beef per Acre	$ / lb Beef	$/Ton Wet	$/Ton DM
		example 1	2		24.0	$550.00	30.69	7.18	49.45	2.59	5.74	70.56	12.00	82.26	0.70	0.43	21.8	2.6	1774	$0.34	$22.9	$74.67
		example 2	1		23.0	$550.00	38.97	7.20	46.35	2.63	4.45	68.80	14.46	81.09	0.70	0.43	23.1	2.9	2223	$0.28	$23.9	$61.36

Figure 2. Sample output page from the Silage to Beef Calculator

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Pricing corn silage

Objectives

- Understand how to calculate the value of corn silage based on the feed value and nutrient removal value of the crop
- Understand the difference in value for the buyer and the seller of corn silage
- Learn about 2 tools to assist in calculating silage value

While old thumb rules typically used corn price to put an approximate value on corn silage, it was based only on the comparative energy substitution value of the silage. However, there are many more factors that affect the true value of corn silage. Dairy and cattle feeders are seeking the lowest cost energy feedstuffs that is palatable, easy to handle and feed, with minimal storage and feeding loss. While the crop producer is trying to take into account the removal of crop residue and nutrients, the loss of the grain sale and possible loss of the stover sale.

Two decision tools are available to assist in calculating a fair price for corn silage, from both the seller and buyer's perspective. Each tool is set up slightly different but calculate similar values from the two different approaches.

The two tools will be compared to show similarities and differences with a set example of inputs. Both tools require realistic corn yields, current corn and hay prices, grain and silage moisture levels, current fertilizer value, and harvest, hauling and storage costs. Both calculate a value for both the buyer and the seller of the corn silage, encouraging the negotiation of the final value.

The key for producers is to recalculate corn silage pricing annually based on their actual production costs for each year.

Differences between the tools

- The ISU tool allows modifying the stover nutrient removal rate while the UW tool fixes the nutrient removal value.
- The ISU tool uses only one corn price, but the UW tool includes both a selling price of corn grain and a purchasing price of corn.
- The UW tool includes grain harvest & storage loss, and silage harvest and storage losses that the ISU tool does not include.
- The ISU tool includes a small grain silage calculator in the same tool, and UW offers small grain and other forage pricing tools separately.
- The UW tool includes a table to adjust silage price based on silage moisture content.
- The UW tool is available as an Android App at this time and will be available as an iOS App this fall.

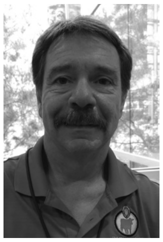
Resources

University of Wisconsin Pricing Corn Silage tool
fyi.uwex.edu/forage/economics

Wisconsin Custom Rates
www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/WI-CRate17.pdf

Iowa State University Pricing Forage in the Field Tool
www.extension.iastate.edu/agdm/crops/html/a1-65.html

Iowa State University Ag Decision Maker Custom Rate Survey
www.extension.iastate.edu/agdm/crops/pdf/a3-10.pdf



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Update on corn silage processing

Objectives

- Update on latest on corn silage processing
- Review assessment of degree of corn silage processing
- Understand corn silage length of cut for dairy cows

There has been recent interest in increasing processed corn silage theoretical length of cut (TLOC) to lengths greater than traditionally accepted USA norms, 26 versus 19 mm (1 versus 3/4th inch). Farms feeding most of their forage as corn silage, desiring more physically effective NDF (peNDF) in the silage to displace dry hay or straw from the TMR, expressed the most interest. Contemporary processors with greater roll speed differential for more aggressive processing facilitated this practice, as proper kernel processing is more difficult to achieve with longer TLOC. But is the longer chop to increase forage particle length really better for the cow?

We conducted two feeding trials with lactating dairy cows comparing 26 or 30 mm TLOC in well processed corn silage to the more conventional 19 mm TLOC. While the as fed percentages of corn silage and resulting TMR on the top screen of the Penn State Particle Separator (PSPS) were greater for the longer-chop corn silage treatments, the percentages on the PSPS top-2 screens combined were similar. Field nutritionists often use the PSPS combined top-2 screen proportions as their forage- or TMR-based indicator of peNDF. We observed no improvements in milkfat content or rumination time, the cow-based indicators of peNDF, for the longer-chop treatments.

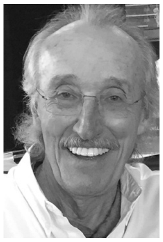
Researchers from Italy, Cornell University and the University of Pennsylvania Veterinary School collaborated on a research publication which involved collection of masticated boluses. Feed treatments were as follows: 6 different particle length ryegrass hays, 1 grass silage, 1 corn silage and 1 TMR. Length of particles entering the rumen in the masticated bolus was not closely related to feed particle length. The critical mean particle length for swallowing the masticated bolus was 10 to 11 mm. While greater forage particle lengths may increase eating time, rumination time and fiber mat formation would not be affected since particles entering the rumen are of similar size due to the initial mastication during eating. Eating time in lactating dairy cows is only 3 to 4 hours per day while the normal time spent ruminating is about 8 hours per day. Time spent ruminating is the major chewing activity contributor to peNDF. Fine chopping forages to lengths at or below the critical size for swallowing the bolus, however, would reduce both eating and rumination times and thus peNDF. Results raise questions about the practice of longer chopping of forages.

More research is needed on longer chopping if the practice continues to be of interest to dairy managers and their consultants. The major potential pitfalls of chopping at too great a TLOC include poor packing in the silo and more sorting in the feed bunk, and, in the case of corn silage, poor kernel processing. These were all assessed in our studies and were unaffected by the long-chop treatments. Whether or not issues in these areas emerge for long-chop silages most likely depends on silage and TMR moisture contents (drier more challenging), harvest equipment type and set-up, and management of the silo packing and TMR mixing/delivery processes. These factors should be considered when fine-tuning TLOC settings on choppers.

Resources

R.D. Shaver website
shaverlab.dysci.wisc.edu

UWEX Team Forage website
fyi.uwex.edu/forage



Keith Bolsen

KEITH BOLSEN SILAGE SAFETY FOUNDATION

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Corn silage safety

Objectives

- Safety begins with a plan that includes written guidelines, policies and procedures, which are posted in break rooms or other areas where employees meet. Guidelines should be clear, consistent, and easy to understand.
- Communication drives success of a safety program, so schedule regular meetings with your silage team to discuss safety and include all employees whether or not they work in the silage program.
- Use zero tolerance when enforcing silage safety guidelines, policies, and procedures, and reward all employees and members of your silage team for safety compliance and accident-free time periods.

One of the major hazards encountered when managing silage in bunker silos and drive-over piles is collapsing silage. Silage avalanches are real and there is no way to predict when and where they will occur. It only takes a fraction of a second for part of a silage feed-out face to silently break off and fall, and the result can be deadly for anyone located beneath it. There have been numerous avalanche fatalities in the USA the past few years, and although rarely reported, we have heard many stories about someone having a near miss with a silage avalanche. Three case studies of avalanche 'near miss' injury accidents and one case study of an avalanche fatality accident are presented here.

Case study 1

Mac Rickels, a nutritionist from Comanche, Texas, almost lost his life the day he took a sample from a bunker silo with a 32-foot high feed-out face. Even though he was standing about 20 feet from the face, 12 tons of silage collapsed on Rickels. His chest hit his knees with such force that it shattered two of the bones in his leg. Fortunately someone was nearby to pull Rickels free. "I didn't see or hear anything. I had been in silage pits hundreds of times, and you just become kind of complacent because nothing ever happens. It just took that one time." (www.silagesafety.org)

Case study 2

I parked the front of my pickup about 12 feet back from the face of a bunker silo that was about 14 feet high. While I was standing about 30 yards away talking to an employee, the silage collapsed. It hit the hood of my truck hard enough that one could easily see the outline of the air cleaner. This supports the recommendation to stay much farther away from the silage feed-out face than the face is tall. (Personal communication from Mr. Richard Porter, Porter Cattle Company, Reading, KS; February 16, 2017)

Case study 3

Doug DeGroff, a dairy nutritionist from Tulare, CA, had pulled samples from a 12-foot silage face and turned to walk back to his pickup. "The sun basically went out … I couldn't see any light and the feed covered me completely. I knew what was happening before I hit the ground. The entire face fell on me … about 20 tons of silage. I remember thinking I don't want to die here today! Thankfully, I was able to brush the feed away from my face, and a nearby dairy employee pulled me from the pile." Fully recovered, Doug says, "I am blessed to be here and everything works. I am physically, mentally and spiritually healthier today than on the day of the accident". (www.silagesafety.org)

Case study 4

On January 13, 2014, Jason Edward Leadingham was working alone in a bunker silo when a massive amount (10 to 15 tons) of corn silage collapsed on him. Pirtle Farms LP of Roswell, NM employed Jason. Jason's body was not recovered from the silage until about 2 and 1/2 hours later, and it was determined that he died of mechanical asphyxia. There was a sample bag near Jason's left hip. He was clutching silage in his hands and had silage in his mouth, which suggest that Jason struggled to survive in the final moments of his life. (www.silagesafety.org)

Figure 1. Doug DeGroff and the actual silage feed-out face that collapsed on him.

We cannot stop avalanches from happening, and they are impossible to predict, but we can prevent people from being under them. Think safety first! Silage-related injury knows no age boundary as workers and bystanders of all ages have been killed in a silage accident. Only experienced people should operate equipment used to harvest, fill, pack, seal, and feed-out silage. It is best to take steps to eliminate hazards in advance than to rely upon yourself or others to make the correct decision or take the perfect response when a hazard is encountered.

Resources

Keith Bolsen Silage Safety Foundation
www.silagesafety.org

Silage Safety 101, 1st edition
Bolsen, K. K. and R. E. Bolsen. 2017. Austin, Texas. Keith Bolsen Silage Safety Foundation. pg. 1-33. www.silagesafety.org

Guidelines to decrease the chance of fatality or serious injury caused by a silage avalanche

- Never allow people to approach the feed-out face. **No exceptions!**
- A rule-of-thumb is never stand closer to the silage face than three times its height.
- Suffocation is a primary concern and a likely cause of death in any silage avalanche. Follow the "buddy rule" and never work in or near a bunker or pile alone.
- Bunker silos and drive-over piles should not be filled higher than the unloading equipment can reach safely, and typically, a large payloader can reach a height of 12 to 14 feet.
- Use caution when removing plastic or oxygen-barrier film, tires, tire sidewalls or gravel bags near the edge of the feed-out face, and wear a safety harness tethered with a heavy rope or cable for fall protection.
- If a payloader must be driven close to the feed-out face in an over-filled bunker or pile, the 'buddy rule' should be strictly enforced. **No exceptions!**
- When standing on top of the silage in a bunker or pile, never get closer to the edge of the feed-out face than its height.
- Do not remove surface spoiled silage from bunkers and piles that are filled to an unsafe height.
- Use proper unloading technique, which includes shaving silage down the feed-out face.
- Never dig the loader bucket into the bottom of the silage. Undercutting creates an overhang that can loosen and tumble to the floor. This situation is quite common when the payloader bucket cannot reach the top of an over-filled bunker or pile.
- When sampling silage, take samples from a front-end loader bucket after it is moved to a safe distance from the feed-out face.
- Never ride in a front-end loader bucket.
- Never park vehicles or equipment near the feed-out face.
- If a new crop is packed against an existing silage feed-out face, mark where the two silages join. Note: Use caution when the feed-out face approaches the joined area.
- Avoid being complacent and never think that an avalanche cannot happen to you!
- A warning sign, 'Danger! Silage Face Might Collapse', should be posted around the perimeter of bunker silos and drive-over piles.

Program Evaluation

Iowa-Wisconsin Silage Conference
Best Western Plus Dubuque Hotel and Conference Center, Dubuque Iowa – June 21, 2018

Overall, how would you rate the conference?

○ Poor ○ Fair ○ Good ○ Excellent

How did you hear about this program? *(select all that apply)*

○ received a brochure in the mail
○ newsletter article
○ radio
○ an email from Extension
○ newspaper/magazine
○ ____________________________

I am a... *(select all that apply)*

○ dairy producer
○ feedlot operator
○ industry representative
○ cow/calf producer
○ custom harvester
○ other ____________________

I currently store silage in a ..... *(select all that apply)*

○ bunker ○ upright silo ○ pile ○ bag

Do you... *(select all that apply)*

○ harvest your own silage ○ have it custom harvested ○ buy standing forages ○ grow all your own

Please indicate your level of understanding and knowledge __before__ and __after__ each session using:
0=none, 1=very low, 2=low, 3=basic, 4=good, 5=excellent

		Before the Conference					After the Conference				
Quality Corn Silage before, during & after harvest	*Dr. Ramirez-Ramirez*	1	2	3	4	5	1	2	3	4	5
Characteristics of corn varieties for silage	*Dr. Shaver*	1	2	3	4	5	1	2	3	4	5
Molds and mycotoxins in silage	*Dr. Gott*	1	2	3	4	5	1	2	3	4	5
Pricing Corn Silage	*Schwab & Halfman*	1	2	3	4	5	1	2	3	4	5
Concurrent Session A											
Corn silage in dairy rations	*Dr. Ramirez-Ramirez*	1	2	3	4	5	1	2	3	4	5
Corn Silage in beef finishing rations	*Dr. Erickson*	1	2	3	4	5	1	2	3	4	5
Concurrent Session B											
Silage and beef calculators	*Dr. Dahlke*	1	2	3	4	5	1	2	3	4	5
Update on contemporary corn silage processing	*Dr. Shaver*	1	2	3	4	5	1	2	3	4	5
Closing Session											
Machinery Effectiveness	*Dr. Luck*	1	2	3	4	5	1	2	3	4	5
Corn silage safety	*Dr. Bolsen*	1	2	3	4	5	1	2	3	4	5

Please continue on the reverse side

How will the topics presented today have an impact on the way you will make, store or improve the feed quality of the silage on your business or operation?

List two things you learned and how will you implement them on your business or operation?

What topics would you like included in future programs?

Demographics

Extension collects this information for aggregate reporting purposes as required by state and federal programs. All information is voluntary and confidential.

Which age range are you in?

○ under 25 ○ 25 – 45 ○ 46 – 65 ○ over 65

Please indicate your race

○ American Indian and Alaska Native ○ Asian ○ Black/African American ○ White
○ Native Hawaiian/Other Pacific Islander ○ Two or more races ○ Prefer not to respond

Please indicate your ethnicity

○ Hispanic or Latino ○ Not Hispanic or Latino ○ Prefer not to respond

Please indicate your gender

○ Female ○ Male ○ Prefer not to respond

Thank you *for your comments and your continued support of Extension education programs.*
Please leave your completed evaluations on the table or in the designated place announced during the program.