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Effects of Harvest Maturity of Corn Silage on the Digestion and Metabolism of Dairy Cows

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The nutritional value of corn silage depends on many factors. These factors include year, hybrid, processing, and maturity. Typically, the corn plant gains dry matter (DM) as it grows. As the kernels of the cob develop, the starch concentration of the plant increases. When the kernels become dented, the milkline (ML) appears. The ML separates the solid starch from the milky starch in the kernels, and the ML moves towards the cob as the kernels mature. The corn plant is fully mature when a black layer (BL) forms at the base of each kernel.

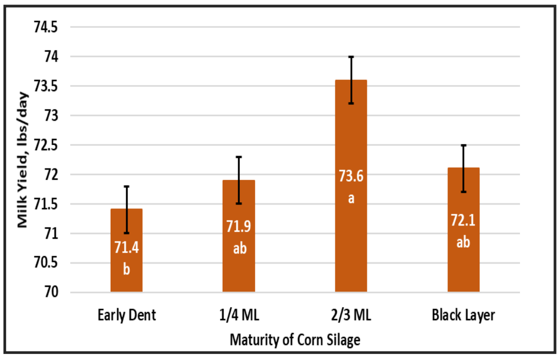

Figure 1. *Milk yield of cows fed varying maturities of corn silage. Milk yield was lowest when corn silage fed was at the early dent stage, and milk yield was the highest when corn silage fed was at the 2/3 milkline (ML) stage. Milk yield decreased numerically when corn silage fed was at the black layer stage (Data from Bal et al., 1997; a-b: difference of $p < 0.05$).*

In the 1960's there was a push to determine at what maturity corn for silage would have the most nutritional value for milk production. Corn harvested between 33 and 36% DM was the most nutritionally valuable for milk production (Huber et al., 1965). Since that time, many practices have changed in the dairy industry. Producers are feeding more grain and less forage now, different corn hybrids have been bred, and cows are producing more milk. Therefore, it is important to re-examine the question of maturity. To answer this question, we need to look at what happens to a cow's digestion and metabolism as she is fed corn harvested at different maturities.

Dry matter digestibility (DMD) increases until corn silage reaches between the 1/2 and 2/3 ML stage and then decreases when corn reaches the BL. This is mainly due to the interaction between starch and fiber digestibility of the corn silage. A study in Washington compared the effects of corn harvested at hard dough, 1/3 ML, 2/3 ML, and BL on the metabolism of Holstein cows (Johnson et al., 2002). Starch concentration of corn silage typically increases with maturity because the kernels are developing. Starch digestion decreased when cows were fed diets containing corn silage harvested at 2/3 ML and BL compared to 1/3 ML. A corn kernel contains both vitreous and floury starch. Vitreous starch is less digestible than floury starch because it is surrounded by a protein matrix that does not allow the microbes to attach and digest the starch. As the corn plant matures, the vitreousness of the kernels increase, causing the starch digestibility to decrease.

The concentration of fiber of corn silage decreases with maturity because as the corn plant matures, grain yield increases. Grain is very low in fiber; therefore, the high proportion of grain late in maturity decreases the overall fiber concentration of the corn plant. Fiber digestibility decreases as maturity advances (Bal et al., 1997). The decline in fiber digestibility is most likely due to an increase in lignin concentration or the environment of the rumen. High levels of starch decrease the pH in the rumen, leading to a poor environment for microbes in the rumen. Therefore, between 1/2 and 2/3 ML, starch digestibility is at its peak for corn silage, but fiber digestibility has decreased with maturity. Because of the peak starch digestibility between 1/2 and 2/3 ML, DMD is still high. When both starch and fiber digestibility decrease at the BL, DMD also decreases.

Even though there are differences in metabolism for cows fed diets with corn silage harvested at different maturities, few studies show a difference in milk yield and milk composition once the corn silage fed to cows reaches 1/3 ML, and milk yield can numerically decrease when corn silage reaches the BL (Figure 1). Therefore, the theory that corn harvested between the 1/2 and 2/3 ML stage (between 33 and 36% DM) is the most nutritionally valuable for milk production still holds true today.

DAIRY SCIENCE

Upcoming Events

See VTDairy for details.

July 6, 13, 20, 27, 2017
Farm Transition and Succession Series 12 pm—3 pm Franklin Co. / $10 covers all

July 9-13, 2017
Southeast Youth Dairy Retreat, Bradenton, FL

July 14, 2017
VA Dairy Expo-Stoney Run Farms

August 2, 2017
Dairy Genomics Meeting Pano's Restaurant, Harrisonburg

August 3, 2017
District Holstein Show & State Colored Breeds Show, Harrisonburg

August 4, 2017
VA Sale of Stars

August 5, 2017
VA Summer Holstein Show

August 15, 2017
Rockingham Co. Fair Dairy Show

August 16, 2017
Keenan Mixer Demo Field Day

August 17, 2017
Rockingham Co. Fair Showmanship

September 29 , 2017
Jr. Dairyman's Contest

September 30, 2017
VA State Fair Dairy Show

Sept. 22 & Oct. 19, 2017
Augusta/Rockingham/ Rockbridge Hay/Forage Quality Superbowl
Samples & Forms deadline: 9/22; Results Program & Dinner 10/19

If you are a person with a disability and require any auxiliary aids, services or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

For more information on Dairy Extension or to learn about current programs, visit us at VT Dairy—Home of the Dairy Extension Program on the web at: www.vtdairy.dasc.vt.edu.

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Precision Dairy Farming Technologies: New Opportunities, New Challenges

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The dairy industry is witnessing the introduction of new technologies to the marketplace at an ever-increasing rate. There are many benefits to technological advances, however new technologies bring new challenges.

Examples of precision dairy farming technologies include: automated milk systems, calf feeding systems, and detection of estrus, as well as rumination monitoring, calving detection, and lameness alerting. These technologies provide a great opportunity to enhance farm management and may improve quality of life for farmers while improving cow comfort and health.

During a recent visit with Virginia Tech Dairy Science faculty and graduate students, Dr. Jeffrey Bewley, Associate Extension Professor at the University of Kentucky, described what might be expected of an ideal precision dairy technology. The technology would: explain an underlying biological process; result in meaningful action by the farmer; be cost effective; be flexible, robust, and reliable; be simple and solution focused; and provide readily actionable information.

> "One must keep in mind that technology is not a cure for marginal or poor management."

As new technologies are introduced, some people rush to be the first to implement. Others watch the early adopters with skepticism and wait for the kinks to be worked out before investing. Still others may never participate for a variety of reasons. When evaluating new technologies, there are numerous considerations. At the 2017 Conference and Expo on Precision Dairy Farming held in Lexington, Kentucky, Dr. Henk Hogeveen from Wageningen University reminded attendees that in order to be successful, precision dairy farming applications need to address a clear problem associated with clear actions. Things one must evaluate before investing in a technology include: economics, ease of use, maintenance requirements, data storage and backups, technical support, and labor requirements. One must keep in mind that technology is not a cure for marginal or poor management.

Automated estrus detection has perhaps been the most widely used precision technology to date. Dr. Julio Giordano from Cornell (2017) identified major difficulties with traditional methods of estrus detection. In general, there is poor compliance with visual observation for heat detection; few farms consistently observe cows for heat twice a day for 30 minutes per session. Secondly, there is a lot of variation in estrus behavior of cows in both number of mounts and duration of estrus. Traditional heat detection programs are labor intensive and repetitive. Giordano highlighted potential benefits of automated estrus detection using pedometers, collars, or eartags to combat difficulties with traditional estrus detection. Continuous monitoring reduces missed heats. Automation also provides an objective evaluation of behavior or physiological status of the cow. A third benefit is the elimination or reduction in labor costs.

Beyond automated estrus detection, much remains to be learned about precision dairy technologies. However, regardless of the precision dairy technology in question, it is known that farmers who implement these technologies cannot afford to be isolationists if they truly want to maximize return on their investments. Technology users should rely on dealers, consultants, and other farmers with the technology to learn more about the system and how to get the most from it. New technologies require an investment in time up front to learn the system. Participation in discussion groups is one way that farmers can enhance their knowledge to better interpret information from systems and consequently make better management decisions.

With careful study and planning before making an investment in a precision dairy technology, challenges associated with the technology may be minimized. For additional information, contact your local Virginia Cooperative Extension office.