

BOTH KERNEL PROCESSING AND LENGTH OF ENSILING TIME play a significant role in starch digestibility and overall feeding value.



Revisiting starch for dairy cows

Starch-related research and application have grown in popularity in recent years. For farms, the reminder is to know what you have and to manage it well.

by Randy Shaver and Luiz Ferraretto

HISTORICALLY, dairy cattle nutrition research and feeding guidelines for carbohydrates have focused mainly on fiber. From this research base, the National Research Council (NRC) has long provided and continually updated the minimum dietary fiber recommendations for maintaining normal milkfat content and rumen function in dairy cattle. Unlike fiber, starch for dairy cattle only has been a hot area of carbohydrate research and field application for about the past decade.

There are several factors that have contributed to the rise in starch-related research and application in dairy cattle nutrition:

- Greater valuing of protein relative to fat as a milk component.
- Greater focus on feed, energy, and nitrogen efficiencies.
- Interest in reducing methane production.
- Improved wet chemistry and NIRS (near-infrared spectroscopy) measurement of starch content in feeds.
- Expanded thinking on intake regulation beyond rumen fill.
- Twofold or greater “new-normal” for the price of corn that largely establishes the cost of starch as a nutrient.
- Establishment of corn silage as the predominant forage crop on many dairy farms.

Starch is contained in the kernel fraction of corn silage and contributes about half of its energy value. The energy value of corn silage influences both the level of milk production and supplemental grain amounts needed in rations. A survey of over 300,000 corn silage samples analyzed by the four major U.S. commercial forage testing labs showed an average starch content of 32 percent, which is relative to an average neutral detergent fiber (NDF)

Shaver is a professor and extension dairy nutritionist in the department of dairy science at the University of Wisconsin-Madison. Ferraretto is an assistant professor in the department of animal sciences at the University of Florida, Gainesville.

content of 41 percent (dry matter [DM] basis).

Clearly, corn silage is an important contributor of both NDF and starch in dairy cattle rations. Corn silage starch content, however, is highly variable as indicated by a normal (two-thirds of samples) range of 25 percent to 39 percent (DM basis) in the commercial lab data set.

This variation is not unexpected since the relative proportion of kernel and stover fractions contained in the whole-plant harvest determine the starch content of corn silage. Although corn hybrid influences grain yield potential and, thus, can impact the potential kernel to stover ratio in corn silage, the actual starch content is largely uncontrolled because it varies greatly depending on crop growing conditions (for example, rainfall amounts and timing), timing of harvest relative to kernel maturity, and cutting height, all of which can alter the kernel to stover ratio during the production and harvest of corn silage.

Therefore, the most important step in optimizing the utilization of corn silage in dairy cattle rations is frequent and accurate sampling and analysis for starch content during feedout. While the focus of this article is on starch, the same can be said for NDF and its digestion parameters to enhance ration formulation and feeding recommendations.

Spotlight on starch digestibility

The starch topic that has been receiving the most attention in recent years relates to factors that influence starch digestibility. It is now well established that both degree of kernel processing and ensiling overextended storage times consistently elevate starch digestibility in corn silage, high-moisture corn, and corn snaplage. Kernel processing breaks apart the pericarp, or outer coat of the kernel, and also expands the surface area of exposed starch granules for microbial access to enhance starch digestibility.

During the ensiling period, proteolysis of zein

proteins cross linked to starch granules in the starch-protein matrix occurs and is likely the primary cause of greater starch digestibility. It also coincides with increases in soluble-protein and ammonia-nitrogen, over time in the silo. This disruption of the starch-protein matrix may also result in some kernel particle size reduction during the ensiling period, which could explain part of the improvement in starch digestibility in storage.

Across two experiments, we observed that corn silage processing score, or the percentage of starch passing through a 4.75-mm sieve during dry sieving in the lab, was bolstered from 7 to 10 percentage units after ensiling in vacuum-sealed plastic bags for at least 30 days and up to 240 days. Additionally, data summarized from two feeding trials suggest that silo baggers may significantly raise the corn silage processing score above what had been measured on fresh material coming from the forage harvester.

Together these observations suggest that corn silage processing score determinations performed on fermented samples obtained from silos prior to feeding may be more accurate than those performed on samples obtained prior to ensiling. The determination of corn silage processing score on samples obtained directly from the harvester for processor setup may be unreliable in some situations. More in-depth evaluation of this issue is warranted.

Hydrodynamic separation of the kernel and stover fractions can be performed on chopped fresh whole-plant corn samples in the field to provide a subjective evaluation of kernel processing at the harvester for processor adjustments as shown in UW-Extension web post <http://on.hoards.com/KerProc>.

Whether through chemical (increased soluble protein) or physical (reduced kernel particle size) changes over time in the silo, length of the ensiling period is a major factor influencing the digestibility of starch in corn silage, high-moisture corn, and corn snaplage. This re-emphasizes that planning and managing inventories to maintain at least four months of carryover in storage for these feedstuffs is a sound practice that can help temper negative effects from delayed harvest maturity or less than excellent kernel processing on starch digestibility.

It is also noteworthy that high-starch feeds ensiled at greater moisture contents, such as corn snaplage, undergo a more extensive fermentation in the silo, which can result in rapid rates and high extents of ruminal starch digestibility after prolonged storage times. This denotes another sound strategy, which is to feed out corn snaplage by late spring. If continuing to feed beyond that time, reduce the proportion of corn silage in the forage mixture to avoid milkfat depression.

Monitoring changes in soluble-protein or ammonia-nitrogen during feedout can be a quick, inexpensive assay indicator of changes in starch digestibility over time in storage for making ration adjustments. 🐄