The variability nesting dolls

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AT A GLANCE

Manage starch digestibility to help ensure rations meet expected values and make the most out of purchased and homegrown feeds.

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Trying to understand how much starch and the amount of energy a cow receives from it can be equated to nesting dolls, uncovering and calculating each layer as we go. Starch can be quite variable in feeds, and frankly, trying to capture this variability can be a lofty task. However, when putting pen to paper, the value of this variability can be quite substantial. Most of us realize the importance of accurate starch values. After all, each pound of digested starch equates to roughly 3.5 pounds of milk. As such, over the years much time and thought has been devoted to devising how to best represent this starch – both from a digestibility and variability perspective.

Each crop year has something unique in store, and 2024 was no different. It also highlighted the importance of closely monitoring starch. Not only have we seen frequent silage swings of +10% starch, but we've also seen huge changes in the starch content of corn grain, with individual dairies bouncing anywhere from 67% to 75% starch. These percentages alone are quite striking, but when we apply them to common ration inclusions, it highlights the importance.

Penciling it out

For instance, consider a high-forage diet consisting of 20 pounds of dry matter (DM) corn silage and 9 pounds of ground corn. On the low end of starch content, we may be providing 6 pounds of starch from corn silage and 6 pounds of starch from grain. Looking at the upper end of starch content, this ration would contain 8 pounds of starch from corn silage and 6.75 pounds of starch from corn grain.

When considering a low-forage diet consisting of 12 pounds of corn silage DM and 11 pounds of corn grain, corn silage may provide anywhere

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FIGURE 1 Ranges of starch and starch digestibility across crop years for corn grain (C, D) and corn silage (A, B)

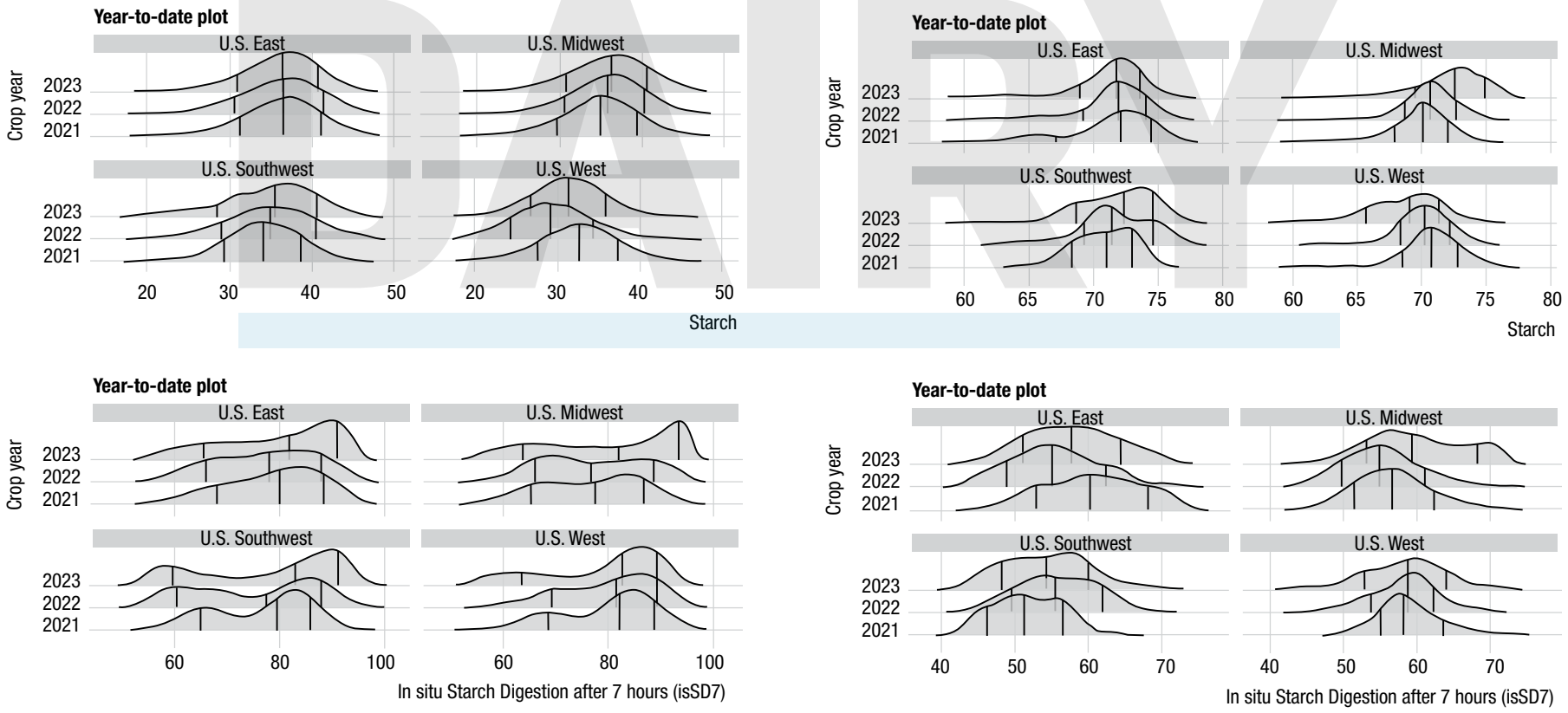
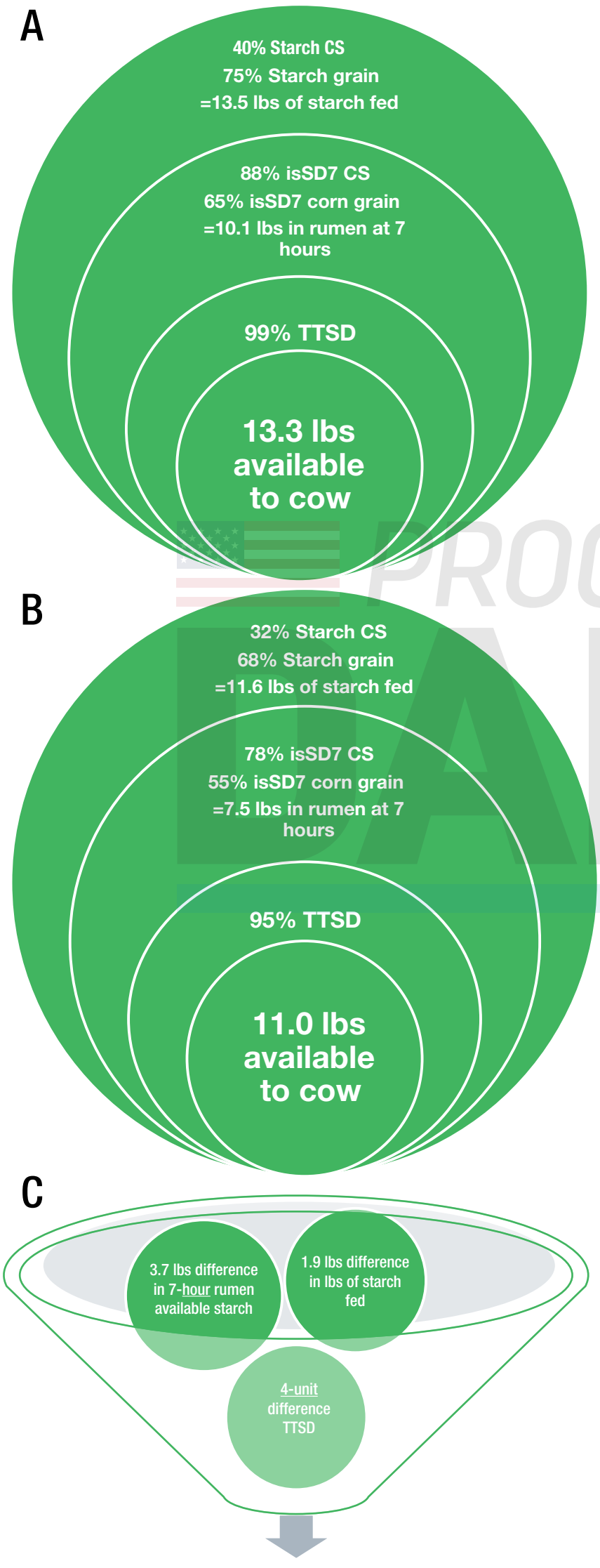


FIGURE 2 Differences in delivered starch between low starch and starch digestibility corn grain and corn silage and high starch and starch digestibility corn grain and corn silage



Corn Silage (CS)
In situ Starch Digestion after 7 hours (isSD7)
Total Tract Starch Digestibility (TTSD)

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from 3.6 to 4.8 pounds of starch, and grain may provide anywhere from 7.3 to 8.3 pounds of starch. This equates to a total dietary starch range of 2.75 pounds for the high-forage ration and 2.1 pounds for the low-forage ration.

Although starch in corn silage can be subject to large on-farm sampling variance, research conducted over a decade ago from Ohio State University found that day-to-day variation in corn silage is the main source of variation in corn silage and recommended sampling and testing two to four times per week for large dairies. This sampling frequency can help us stay on top of large starch changes that may otherwise go undetected and help us catch these changes faster. Additionally, the 1-pound-plus swings we frequently see within farms feeding corn grain demonstrate the importance of including corn grain in a routine sampling program.

Where's the starch?

These aforementioned metrics only look at starch content, not total tract or rumen starch digestibility. Both of these are valuable tools that can help us assess the energy content available to the cow for things such as milk production or body reserves. Rumen starch digestibility is an analytic tool that can give greater insight into what starch will be potentially available in the rumen and estimates at what rate it digests in the rumen. This will then be converted into volatile fatty acids (VFA), primarily propionate, which is a major driver of milk production. Most of the starch that is not digested will pass into the hindgut and get digested there. The remaining starch will pass through the cow unutilized and can be estimated using fecal starch. Fecal starch analysis can be used to predict total tract starch digestibility and give a view of the whole digestibility picture.

Variability exists in both rumen digestibility and total tract digestibility due to a multitude of factors, including but not limited to maturity at harvest, dry matter, growing conditions and processing. When looking at laboratory-observed ranges, we have seen within-farm starch digestion standard deviations of up to 7.5% for corn grain in a given year. When looking at other major starch sources, such as corn silage, we routinely see greater than 7% starch variability in a single pile. This variation is particularly substantial when opening new corn silage, especially those with reduced fermentation times. The range in starch and starch digestibility can be observed in **Figure 1** (page 33).

We know the postruminant digestive system has a great ability to compensate for lacking rumen starch digestibility; however, there is still quite the range when looking at total tract starch digestibility. Fecal starch values can range from upwards of 10% to less than 1%. Too much postruminal starch can increase the risk of hindgut acidosis, which can lead to further health issues.

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So, what does this variability all mean? What is truly at the center of all these nesting dolls? When we put numbers to each of these layers, we can see the true impact that variability in starch can have on the energy available to the cow from these feeds. **Figure 2** shows the impact each of these can have on the result when we couple high-starch and starch digestibility feeds (a) or low-starch and starch digestibility feeds (b) in a diet feeding 15 pounds DM corn silage and 10 pounds DM corn grain and the difference between them (c).

NASEM starch changes

New changes to the 2021 Nutrient Requirements of Dairy Cattle from the National Academies of Sciences, Engineering and Medicine (NASEM) energy equations help nutritionists and producers account for differences in starch digestibility. They also work to show the impacts of total starch level and digestibility on the diet as a whole. The model has moved away from total digestible nutrients (TDN) for individual feeds and instead looks at TDN only on the whole diet so that these interactions can be accounted for.

Ration balancing models can help producers assess the impact of these starch content and digestibility changes on total dietary energy to better predict cow response. However, having and maintaining the correct values in these programs is an essential step. For instance, in the Cornell net carbohydrate and protein system (CNCPS) model, researchers found that a one-unit change in the standard deviation of corn silage starch equated to a 0.29 kilogram per day difference in predicted metabolizable energy (ME) allowable milk production. The digestible fraction of the corn grain starch had a large impact on both predicted ME allowable milk and metabolizable protein (MP) allowable milk.

Although managing starch digestibility may feel like uncovering the center in a never-ending set of nesting dolls, there are many tools available to help us start to break this down. Doing so can help ensure that rations meet expected values and help farmers make the most out of purchased and homegrown feeds. It can also shed light on opportunities to improve starch digestion and ensure we aren't missing out on valuable energy.

References omitted but are available upon request.