



Cumberland Valley
Analytical Services

SOLUBLE STARCH

A NEW CONCEPT FOR CHARACTERIZATION OF CORN SILAGE AND CORN GRAIN

Introduction:

CVAS is pleased to announce a new starch characterization test: “**Soluble Starch**”. This assay is part of an evolving investigation spanning a number of years as to how to better understand starch availability and degradability from a ruminant feeding perspective. The Soluble Starch assay helps define fine starch particles that readily wash from the sample. Knowing how much starch rapidly releases into the rumen helps build a more complete understanding of starch degradation differences between samples.

The Assay:

We are defining “soluble starch” as the amount of starch that passes through a 50-micron sieve when an as-received corn silage or corn grain material is washed with room temperature water. The starch is technically not solubilized but washes out and is in suspension.

By NIR: CVAS will provide this assay as an add-on to the NIR Plus package for \$8.00 per sample. The assay will utilize NIR for determining the beginning starch and residual starch after a physical washing. This assay will typically be available the day following reporting of the NIR analysis. This analysis is available for corn silage, corn grain, and TMR samples.

By chemistry methods: We will provide this assay using chemistry methods for starch analysis of the beginning and ending starch fractions. The assay will be available with analysis packages providing starch. Turn-around will be concurrent with general chemistry analysis. Sample types that may be evaluated include corn silage, corn grain, TMR as well as other starch containing materials of interest. The cost by chemistry is \$23.50 per sample.

History and Context:

CVAS was one of the first commercial providers of 7hr in vitro starch digestibility assays many years ago. This evaluation has brought value to the feed industry but also much frustration as it does not go nearly far enough in characterizing rumen functional characteristics. It relies on an evaluation of dried material processed through a knife mill and is a measure of “fragility” as impacted primarily by integrity and strength of the starch to zein protein matrix. It provides opportunity to rank feeds but lacks sensitivity, does not speak to as-fed particle characteristics, and does not lend itself well to modeling by NIR.

Twelve years ago, CVAS introduced the Corn Silage (or Kernel) Processing Score (CSPS) developed by Dr. Dave Mertens. CSPS is a measure of the percent of starch from a dried unground corn silage sample that passes through a 4.75 mm screen. While this evaluation was designed to evaluate the adequacy of processing, it has been used as a surrogate measure of starch availability which has limited nutritional utility.



An example of the “wash for a corn silage with suspended starch shown in the flask.



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Several years ago, we worked to improve the CSPA assay by using a wet-sieving technique, washing un-dried corn silage samples using a 4.75 mm screen (the CSPA screen definition). Initial results on corn silage samples assayed in November yielded results on average similar to the CSPA. Data was summarized for presentation at ADSA in 2018 ([Abstract #354](#)). Follow-up evaluation in May yielded results that were very different from those initially obtained. Instead of a test set mean of 64% of starch passing through a 4.75mm screen, we were obtaining significantly increased passthrough with values 70% to 80%. After much head scratching, we decided that we were measuring the breakdown of corn grain impacted by time in storage.

This spring, working to evolve the wet-sieving approach, we tried progressively smaller screen sizes working down from 4.75 to 0.80 mm. There was no noticeable difference between the amount of starch passing through any of those screens using a wet-sieving technique. Washing samples through a 50- micron sieve yielded similar results. Subsequently we have run a number of samples of corn silage from fresh to well fermented, as well as dry to very wet fermented corn grain. We found that there is significant range in the amount of starch that goes into suspension and passes through a 50-micron sieve as various samples were evaluated.



The wet sieving unit developed by CVAS. The unit moves the sieve up and down in water approximately 60 times per minutes to wash particles through the 4.75 mm sieve aperture.

Example Soluble Starch Data

Corn Silage			High Moisture Corn		
DM%	Starch%	Soluble Starch, %Starch	DM%	Starch%	Soluble Starch, %Starch
37.7	29.4	26.1	73.5	76.7	34.2
45.9	39.1	32.9	72.4	77.0	36.8
36.7	33.8	40.2	71.5	73.2	37.4
42.0	35.3	45.4	74.3	78.8	56.8
38.3	34.6	61.4	70.9	75.6	57.4
32.5	31.5	66.9	67.1	60.1	88.6
37.2	40.1	68.3			
38.1	36.6	74.4			
34.7	29.9	74.6			

Potential Opportunities:

We are excited to bring out this assay as we move into the new crop year for corn silage and fermented corn grain. We believe that we will be able to observe significant changes in starch characteristics as we consider “soluble starch” values over time in storage. We are looking forward to working with our clients in a discovery process considering how dry matter at ensiling, degree of processing, fermentation, and time in storage impact this characterization. We will be providing summaries of soluble starch over time along with other fermentation indices.



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Although the soluble starch is assayed by NIR or by chemistry, the characterization is a physical evaluation. It is a repeatable assay with a distinct range, it is relatively simple to execute and not costly to deliver. Importantly, we believe that it has characterization value in understanding the crop and providing insight into how the starch is utilized in the ruminant system. Soluble starch is part of a new starch evaluation model that CVAS is developing to provide value to the industry.

Feeding and Modeling Implications:

In a recent conversation with Dr. Mike Van Amburg regarding this “soluble starch” assay he made the following comments: “The reported repeatability of the analysis suggests that as the amount of starch passing the 50-micron sieve increases, the extent of rumen digestion will increase. This also suggests that the rate of digestion of the starch will increase, as these particles will have greater surface area for microbial digestion. There might be conditions where rumen fill of aNDFom is not adequate, both fiber and liquid passage is higher than expected, and this “soluble” starch will escape fermentation. However, under consistent feeding conditions, this characterization should provide information to improve our understanding of rumen available starch. In our in-vitro work, we have always observed a large fraction of starch that “disappears” within 3 hours of the initiation of the fermentation and this characterization supports the idea of a rapidly fermentable fraction. This approach will require more quantitative evaluation to provide robust rates of digestion and pool size for use in diet formulation.”

As we have explored this concept with multiple nutritionists and ruminant researchers, we have received various perceptions of how this “soluble starch” will function in the rumen. However, there is general agreement that this assay has significant potential value in characterizing starch.

Submission of Samples:

Corn Silage and Corn Grain samples submitted for the “soluble starch” assay should be sampled and sent to the lab as you would for a routine NIR assay. Make sure that a full quart bag of material is sent. The assay is available when requesting the NIR with a Plus Option and asking for “soluble starch”. It may be requested with a chemistry package that includes a starch. The “in-soluble” fraction will then be measured by chemistry.

Remember to request “soluble starch” specifically as many of the bags and sample forms do not have a box to check. To add value to the assay for soluble starch, please include the “date of ensiling”. This should provide additional valuable information as we track the impact of time in storage on soluble starch levels.

Availability of Assay:

The soluble starch assay will be available beginning September 1 at our Waynesboro PA lab, our Batavia NY lab, and Madison WI lab. If you use one of our affiliated labs, please contact them for availability of the assay.

For **additional information** or to provide feedback on this concept please contact Ralph Ward at rward@foragelab.com or Matt Michonski at mmichonski@foragelab.com. General information may be found at www.foragelab.com.