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# Forage Quality Control

APPLICATION BRIEF

Forages are the key component of ruminant diets, and optimizing the rations is often the key to profitability for dairy and livestock producers. Poorly balanced rations can lead to low milk production in dairy cows and slow weight gain for beef cattle.

Forage is typically roughage (whole plant leaves and stems) that is fed to ruminant animals (dairy cows, beef cattle, and horses) to provide nutrition. Hay forages can be dry grass hay, legume hay and mixtures of the two. Haylage is hay that has been allowed to ferment in a silo for a period of time. Haylage and corn silage are forage materials and corn plants, respectively, that are partially dried and chopped for storage. These wet forages are then fermented separately in tower silos or air tight horizontal storage bunkers.

Forages show wide variations in nutritional content, and frequent and accurate analysis is key to properly optimizing animal rations.

## FORAGE QUALITY CONTROL MADE SIMPLE & FAST WITH NEAR INFRARED (NIR) TECHNOLOGY

Basic forage analysis consists of at least dry matter, crude protein, crude fiber, ADF, NDF, and ADP as well as several minerals. Often some measure of digestibility as well as calculated parameters for energy availability is included. These data are laborious, time consuming and expensive to obtain from traditional wet chemistry methods.

NIR analysis of forages can produce 20 or more compositional and property values in less than a minute from dried ground forage samples with an accuracy rivaling the wet chemistry methods but offering superior repeatability. Samples can be analyzed rapidly with one analyst and no dangerous procedures or chemicals.

NIR forage analyzers are in widespread use for larger livestock and dairy producers, analytical laboratories, plant breeders and university researchers. Most forage analysis is performed with dried and ground samples, though calibrations are available for fresh forage samples directly from the field.

## FORAGE TESTING SPECIALISTS

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|---|---|
| **University Researchers** | University researchers are leading the way to identify new analytical tests to predict animal performance from feeds and forages. Many of these analytical tests, such as various lignin assays and digestibility tests, have been used as reference methods for new NIR calibrations. |
| **Forage Testing Laboratories** | The forage testing laboratories are on the front lines in producing timely data for producers. The rapid testing time means that the nutritional values are available for real-time ration balancing, allowing for more precise control of the diet, efficient use of expensive supplements, and better animal performance. Many are developing innovative methods to return the data back to the producers over the internet for immediate use. Forage testing laboratories are constantly developing and implementing new calibrations into their packages, giving producers instant access to new and novel parameters with each NIR analysis. |
| **Livestock Farms** | Sites with a larger number of dairy cows now frequently run their own testing of forages using NIR. The availability of starter calibrations and the simplicity of use of today's analytical equipment offers the added advantage of "on the spot"# optimization there by increasing yield and profitability. |

*SpectraStar™ XT Series NIR Analyzers, shown above, offer outstanding accuracy and reliability for rapid compositional analysis of solid, slurry, or liquid samples.*

## TECHNOLOGY OPTIONS FOR FORAGE ANALYSIS

Forage analyses are some of the most demanding of NIR applications, yet the amount and speed of the results offers some of the biggest and fastest payback potentials. Forage analyses are demanding because of the complex nature of the sample types, along with the specificity and breadth of the constituents required. To model all of the sample variation and provide the spectral information necessary to predict these constituents requires many calibration samples with high quality spectral data. Noisy or low resolution spectral data will require many more calibration samples and be limiting in the accuracy and repeatability of the analysis.

For these reasons, a scanning monochromator such as the SpectraStar™ XT-R analyzer is the best solution for laboratory or at-line analysis of forages. Scanning monochromator-based instrumentation is the most widely used technology in the world for forage analysis with thousands of analyzers in use and time proven results. Instrumentation of this type will provide the sample analysis capability to analyze many sample types for the most difficult parameters with the lowest calibration and validation requirements.

## THE VALUE OF NIR TO FORAGE ANALYSIS

As described above, the parameter values desired for a complete analysis of forage are numerous and diverse. In general, these tests are laborious and / or involve dangerous chemical or expensive apparatus. To estimate the monetary value of NIR in forage analyses, the average cost from analytical laboratories for the various parameters are listed below.

| Forage Quality Parameter | Euro | $ USD | Time (Hours) |
|---|---|---|---|
| Dry Matter | 10.00 | 12.00 | 24 |
| DM, CP. NDF, ADF | 30.00 | 39.00 | 48 |
| Minerals | 20.00 | 26.00 | 24 |
| Lignin, Fat, Ash, Starch, ADICP, NDICP | 40.00 | 52.00 | 72 |
| Digestibility | 80.00 | 91.00 | 120 |
| **TOTAL** | **€179.00** | **$221.00** | |

Even accounting for package discounts, the costs above demonstrate that a SpectraStar XT Series NIR Analyzer can be paid for after only 500 samples.

However, the monetary cost analysis ignores the value of the data itself. Traditional wet chemistry testing will require days to return the data, meaning the forage tested has long been implemented into the rations and limiting the impact of the results on formulating the diet. NIR results can be ready in a matter of hours, requiring only drying and grinding the sample followed by a one minute analysis.

The rapid testing time means that the nutritional values are available for real-time ration balancing, allowing for more precise control of the diet, efficient use of expensive supplements, and better animal performance. Low costs and quick results also allows for more frequent testing also contributing to better control of the animal diets.

## ABOUT THE SPECTRASTAR™ XT SERIES NIR ANALYZER

From analyzing moisture, protein, fat, sugar, and fibers, to more complex parameters such as ash, fatty acids, and lignin, the SpectraStar™ XT NIR Analyzer Series is trusted by thousands of quality laboratories and production facilities to enhance their processes and make data-driven decisions.

- Obtain vital quality parameter data in about 30 seconds, enabling quick response for quality control.
- Access an extensive library of robust calibrations developed from hundreds-to-thousands of samples. Calibration customization is also available.
- Minimal sample preparation, only minimal training required, and environmentally friendly.
- Available with KPMLink®, a cloud-based software suite to support the real-time remote configuration of product settings, calibrations, and more.


**Ready-to-Use SpectraStar XT-R Calibrations for Forages**

| SUBSTANCE | CONSTITUENTS | SAMPLING ACCESSORIES | PART NUMBER |
|---|---|---|---|
| Corn Cob Mix CCM | Dry Matter, Protein, Fiber, Ash | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-051 |
| Corn Silage | Dry Matter, Protein, Ash, Fat, Starch, Sugar, Fiber, ADF, ADFom, NDF, NDFom, Enzyme Soluble Organic Matter, Ca, P, K, Mg | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-043 |
| Grain Silage | Moisture, ADF, NDF, Protein, Ash, Fat, Starch, Ca, P, Mg, K | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-025 |
| Grass Hay Expanded | Moisture, Protein, Fat, Fiber, Sugar, Starch, Ash, ADF, ADFom, NDF, NDFom, Mg, K, Ca, P, WSC, ESC, Gas Production, Enzyme Soluble Organic Matter, Vitamine A, Vitamine B1, Vitamine B3, Vitamine C | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-192 |
| Grass Silage | Dry Matter, Protein, Soluble Protein, Ash, ADF, NDF, Lignine | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-056 |
| Green Maize | Dry Matter, Protein, Ash, Fat, Starch, Sugar, Fiber, ADFom, NDFom, Enzyme Soluble Organic Matter | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-063 |
| Hay - Grass | Moisture, DM, Protein, ADF, NDF, Fat, P, Ca, K, Mg, dNDF8, Ash, Lignin, DP, ADP | US-ISIH-0307 Ring cup | US-CALB-153 |
| Hay - Alfalfa | Moisture, DM, Protein, ADF, NDF, Fat, P, Ca, K, Mg, dNDF48, Ash, Lignin, DP, ADP | US-ISIH-0307 Ring cup | US-CALB-154 |
| Hay - Mixed | Moisture, DM, Protein, ADF, NDF, Fat, P, Ca, K, Mg, dNDF48, Ash, Lignin, DP, ADP | US-ISIH-0307 Ring cup | US-CALB-155 |
| Haylage | Protein, Fiber, Fat, Ash, Ca, P, Moisture, Sugar, pH | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-059 |
| Legumes | DM, Protein, Fat, Fiber, Sugar, Ash, ADFom, NDFom, Gas Production, Enzyme Soluble Organic Matter | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-144 |
| Plant Mix Dry | Dry Matter, Protein, Fiber, Fat, Sugar, Starch, Ash, ADF, NDF, ADL, Enzyme Soluble Organic Matter, Enzyme Insoluble Organic Matter, Gas Production, oNDF, oADF, C, Ca, K, Mg, N, P, C/N | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-134 |
| Total Mixed Ration TMR | Moisture, Protein, Fat, Ash, Fiber, Starch, Sugar, ADF, ADFom, NDF, aNDFom, Lignin, Invitro_Dig, Ca, P, Mg, K, Na, S, Cl, ADL | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-041 |
| Wet Forage | Moisture, Protein, Starch, NDF, iNDF, Ash, Propionic Acid, Butyric Acid, Acetic Acid, Formic Acid, Ethanol, pH, NH4-N | US-LGOP-0001 Large Open Cup with plunger | APPS-CALB-198 |

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