EXTENSION

AGRICULTURE

A Guide to Assessing Forage Quality for the Dairy

Heather Darby, Extension Professor and Agronomy Specialist, University of Vermont Extension
Sara Ziegler, Agronomy Research Specialist, University of Vermont Extension
Kurt Cotanch, Dairy nutritionist, Barn Swallow Consulting
Sarah Flack, Grazing livestock consultant, Sarah Flack Consulting

Sensory Assessment

Visual and olfactory (smell) characteristics can give you some quick and useful information about your forages. While they should not be used alone to determine forage quality, they can help in detecting fermentation issues and possible pathogen growth that could be harmful to livestock.

Are there seed heads, flowers, or seed pods present?

This indicates plant maturity at harvest which will influence fiber content and fiber digestibility.

Are there a lot of leaves or a lot of tough stems?

More stems suggest higher fiber and lower fiber digestibility.

Is the forage bright green, brown, black, or white?

The color of forage can indicate potential fermentation problems. Forage with excessive acetic acid will have a yellowish hue, while those high in butyric acid can be slimy and greenish color. Brown to black silage usually indicates heating from fermentation and moisture damage. Forage that is white is usually indicative of secondary mold growth.

Does it smell sweet like tobacco or caramel? Vinegar? Fruity/alcohol? Musty, moldy, or dead animal?

This can indicate that the forage has undergone less than ideal fermentation. Heat damage will cause the caramelized tobacco odors. A vinegar smell can indicate more acetic acid than lactic acid produced. An alcohol smell may be due to the presence of yeasts. Musty moldy smells indicate mold growth which can reduce intake and produce mycotoxins that could be harmful to the animal. Feed that smells like rotting meat or dead animal should not be fed. These indicate potential clostridia contamination and can be dangerous to animal health. Forage that has these off-smells may also indicate the feed was put up too wet, too dry, or with lots of soil contamination.

Chemical Assessment

Taking a sample

Using a hay bale probe and taking several cores from the long side of several round bales will provide the most representative sample. If you do not have access to a probe, make sure to collect forage from throughout the whole bale at feed out. Put your forage sample in a quart sized plastic bag; if you send more than a quart bag, often labs will charge you an extra fee so don't send too much. Label the bag clearly with a label that you will remember what it refers to and matches the paper submission form from the lab. Keep your samples cool until you ship them, ideally within a couple days of taking the samples. You can freeze the samples but that is not required. Ship the samples to the lab as quickly as possible to prevent spoilage during transit. The labs typically report results back within 5-7 business days depending on the type of analyses requested.

Labs and analyses

First, it is important to recognize that there are two methods of analyzing forage quality in the lab: Near Infrared Reflectance Spectroscopy (NIR) and wet chemistry. NIR analysis is less expensive as no chemical analysis is performed whereas wet chemistry involves various chemical treatments and digestions to quantitatively measure forage nutrient components. With NIR, light is shined at the sample and the spectra of light that is reflected is captured. Since the amount of each wavelength of light that is reflected is related to the various nutritive fractions of the forage, these spectra can be used to "calculate" the nutrient content of the forage. The equations used to do these calculations are based on the lab's database of wet chemistry samples and therefore it is best to choose one company and stick with them; comparing analyses from different labs will be variable as their databases and calculation models likely differ.

It is also important to realize that, while NIR is less expensive, the accuracy of some metrics is much lower than with wet chemistry. This is particularly true for minerals. While you will receive individual mineral concentrations if you request an NIR analysis, these can vary widely in accuracy and should not be used to inform changes in mineral supplementation or soil fertility management. If any of the mineral results from an NIR analysis are concerning, wet chemistry should be requested.

Finally, most labs will also provide a range of values relating to relative quality (RFV or RFQ), energy content (NEL, TDN, etc.), or milk production potential (milk per ton). These metrics are calculated through mathematical equations and these equations may differ between labs. Therefore, it can complicate interpretation of these values especially if you send samples to different labs. Hence, these values should be used with caution.

The table below outlines key parameters that are critical in evaluating forage quality and balancing animal rations to optimize nutrition and meet animal productivity and health goals. These parameters include dry matter, fiber and fiber digestibility, protein, sugar, starch, ash, and minerals as well as pH and volatile fatty acids for fermented feeds. This document contains a list of forage testing laboratories in the northeast that provide forage testing services and suggested analysis packages to obtain these key parameters.

Interpreting the results

When you receive your results, it can be overwhelming to sift through all the numbers and try to make sense of them. Below is a short table of some of the key metrics to pay attention to and benchmarks you may want to meet if you are feeding lactating dairy cows. If your forages don't meet these benchmarks, they are likely suitable to feed animals with lower nutrient requirements such as dry cows or heifers. Lactating dairy cows that are fed lower quality forage can be expected to have low milk production unless other supplements are available.

Key Forage Quality Metric Benchmarks for Lactating Dairy Cows

Quality Metric	Target
Dry Matter (%)	45-55% baleage 35-45% haylage >85% dry hay
aNDFom (% of DM)	<55%
NDFD30hr (% of aNDFom)	>60%
Volatile Fatty Acids (VFAs)	
Lactic acid (% of DM)	>5%
Acetic acid (% of DM)	<2.5%
Butyric acid (% of DM)	<0.25%
pH	<5.5
Ash (% of DM)	<8% grasses <11% legumes
Metabolizable Energy (ME, Mcal/lb)	>1 Mcal/lb
Crude Protein (% of DM)	14-16%
Ammonia-N (% of CP)	<12%
Minerals	Low accuracy via NIR, request wet chemistry
Ca (% of DM)	< 1.5%
P (% of DM)	< 0.7%
Mg (% of DM)	<0.6%
K (% of DM)	< 3% for lactating cows <1.5% for dry cows
Ethanol Soluble Carbohydrates (ESC, % of DM)	>10%
Water Soluble Carbohydrates (WSC, % of DM)	>12%
Crude Fat (EE, % of DM)	2-5%

It is best to consult a dairy nutritionist to determine optimal ration balancing and mineral supplementation. Since many dairy nutritionists are connected to feed/ supplement companies and only provide services to customers purchasing those products, grass-fed dairy producers may seek out independent nutritionists for consultation which will likely require a fee-for-service. Below is a list of some independent dairy nutritionists who service the northeast and may be able to assist you.

This list is not exhaustive and is not intended to endorse any specific business, it is simply a collection of nutritionists in the region we are aware of that provide consulting services to grass-fed dairy farms. If you are interested in knowing more about a particular nutritionist's availability and services, please contact them directly.

Independent Dairy Nutritionists Serving the Northeast

Bill Kipp
Independent Dairy Consultants Inc.
Middlebury, VT
802-388-0585

Kurt Cotanch
Barn Swallow Consulting
Underhill, VT
802-363-4406

Michael Conroe
Dairy Pro LLC
New Berlin, NY
607-371-3677

Forage Testing Laboratories in the Northeast

The suggested analysis packages were chosen to provide the most important forage quality metrics and comparable results packages between the companies. This list is not exhaustive and is not intended to endorse any specific business. Complete information on analysis packages, pricing, submission forms, and other information can be obtained by contacting the

Cumberland Valley Analytical Services (4999 Zane A Miller Dr. Waynesboro, PA 17268; 301-790-1980)

Package	Code	Cost per sample
Standard "NIR 1" analyses of fiber, fiber digestibility, protein, carbohydrates, minerals, and fermentation profile	A 1 Plus	$33.75
"NIR 2"- same as A1Plus above + wet chem minerals (Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu)	A 2 Plus	$47.25
"NIR 3"- same as A2Plus above + wet chem minerals DCAD (Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu)+(Cl, S)	A 3 Plus	$57.25
Wet chemistry minerals only (Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu) + ash	B 6	$35.50
Wet chemistry fermentation analyses (VFA + Ammonia CP) **Can be added to NIR packages: example A1Plus F1*	F1	$40.00

Dairyland Laboratories Inc. (Suite 206, 1817 Olde Homestead Ln. Lancaster, PA 17605; 717-517-7955)

Package	Code	Cost per sample
Standard NIR analyses of fiber, protein, carbohydrates, mineral and fermentation including Fiber digestibility	CNCPS 6.5+	$33.00
Wet chemistry (basic minerals) Ca, P, Mg, K, S	M2	$15.00
Wet Chemistry (DCAD): Ca, P, Mg, K, S, Na, Cl	M3	$17.00
Wet Chemistry (Complete minerals): Ca, P, Mg, K, S, Na, Fe, Mn, Zn, Cu, Al, B	M4	$29.00
Wet Chemistry (Complete minerals with DCAD): Ca, P, Mg, K, S, Na, Fe, Mn, Zn, Cu, Al, B & Cl	M7	$33.00
Wet Chemistry Fermentation (VFA) Volatile Fatty Acid Profile: CP, Ammonia as % of CP, pH and fermentation acids	VFA	$48.00

DairyOne Forage Laboratory (730 Warren Road Ithaca, NY 14850; 607-375-9962)

Package	Code	Cost per sample
Standard NIR analyses of fiber, fiber digestibility, protein, carbohydrates, minerals, and fermentation profile	327 (NIR Pro)	$31.00
Wet chemistry minerals (Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu) **Can be added to NIR packages*	329	$12.00
Wet chemistry minerals DCAD (Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu + (Cl, S) **Can be added to NIR packages*	331	$24.00
Wet chemistry fermentation profile (VFA + Ammonia CP) **Can be added to NIR packages*	207	$29.00

Rock River Laboratory (21 Kattelville Road Binghamton, NY 13901; USPS address PO Box 34, Chenango Bridge, NY 13901; 607-766-5363)

Package	Code	Cost per sample
Standard NIR analyses of fiber, fiber digestibility, protein, carbohydrates, minerals, and fermentation profile	Dynamic NDFD	$27.00
Wet chemistry major minerals (Ca, P, Mg, K, Na, Cl, S) **Can be added to NIR packages*	Major Minerals	$17.00
Wet chemistry total minerals (Ca, P, Mg, K, Na, Cl, S Zn, Fe, Cu, Mn) **Can be added to NIR packages*	Total Minerals	$25.00
Wet chemistry fermentation profile (VFA + Ammonia CP) **Can be added to NIR packages*	Fermentation profile	$40.00

NIR Analyses- *good for dry matter, fiber and fiber digestibility, protein, sugars and starch. Minerals are included but inaccurate for precise nutrition adjustments.*

Wet Chemistry- *more accurate than NIR for mineral analysis. Essential to evaluate dry cow minerals for DCAD (dietary cation-anion difference), Na, K, S & Cl; Milk fever concerns. Necessary for accurate mineral supplementation of all livestock classes.*

Wet Chemistry Fermentation Profile – *good to identify proper fermentation of feed and identify potential harmful levels of ammonia and butyric acid.*

Strategies to increase the amount of milk sold in total and per cow on a grass-fed dairy farm

How could shipping more milk off the farm help farm finances? More cwts (hundredweights) of milk shipped allows dairy farm expenses to be divided over more milk. This can lower the cost of production and increase net income per cwt. But this only works if the increase in milk doesn't raise your costs too much. The following is a list of some strategies to increase the amount of milk sold per cow.

- **Minimize cow time budget interference**- cows have finite time budgets each day for tasks such as eating, resting, and socializing. In total they need over 20 hours of time to fulfill these needs. This leaves only a few hours for milking, handling, sorting, administering medicine, and other tasks. Any time beyond that or otherwise restricting their natural expression of this time budget can have health and productivity implications.

Activity	Time spent (hrs)
Eating	5
Lying/resting	12-14
Standing, walking, grooming, etc.	2-3
Drinking	0.5
Total needed	**~21**
Leaves about 3 hours for milking and all other handling needs	

- **Reduce crowding** – this can help cows produce more milk in several ways:
  - **Reduces competition for feed** and can increase forage intake. Cows only spend about 5 hours/day eating so any limitation in feed access can severely limit dry matter intake and production. Maintain 24-30 inches of bunk space per cow.
  - **Reduces stress**.
  - **Increases lying time** by improving access to dry, clean places for cows to lay down and rest. When cows are laying down, blood flow to the udder increases and they make more milk. Maintaining stocking density <120% will help provide adequate lying and resting time. Every 1 hour of increased resting time can equate to 2-3.5 lbs of milk production.
- **Improve reproduction** – getting cows bred back on time, and closely monitoring heats, conception and pregnancy rates will assure that milk production doesn't drop due to poor reproductive performance. Keeping some records (or using a service that does that for you such as Dairy One or DHIA) allows you to track reproductive performance metrics:
  - **Calving interval**- This is the amount of time between calvings and should be maintained between 12-13 months. Longer calving intervals may be a function of nutritional, breeding, or heat detection issues.
  - **Day in Milk (DIM)**- Herd average should be 160-170 days for herd milking year-round.
  - **Pregnancy rate**- This is the number of pregnant cows per number of eligible cows. A good goal is 20% but this can be variable in small herds where one cow represents a larger percentage of the herd.
  - **Services per pregnancy**- This is the number of times a cow is inseminated before a positive pregnancy diagnosis. If this number differs between pregnant cows and all cows, then certain cows are not getting bred.
- **Genetic selection and improvement** – by breeding the cows in the herd that are doing the best under grass-fed management (making enough milk, breeding back on time and staying healthy) to a bull with good genetic traits and then only keeping those best heifer calves, herd productivity will improve over time.
- **Youngstock decisions and management**
  - **Determine how many replacements are needed to match your cull rate.**

    Formula: (Milking + Dry cows) **x** cull rate **x** (age at first calving / 24) **x** (1 + heifer noncompletion rate) **x** 2

    Note: Cull rate includes animals that die. Heifer noncompletion rate includes heifers that are born alive but die before they are sold or calve.

    Example: (50+10) **x** 28% **x** (26 / 24) **x** (1 + 12%) = (60) x (0.28) x (1.083) x (1.12) = 41

    - Raising more heifers than you need to replace culled cows directly lowers the amount of milk left in the tank to sell. Grass-fed calves are fed on average 1.75 gallons of milk per day for over 5 months. This is an opportunity cost and a direct loss of milk income.
  - **Grow heifers quickly-** Make sure heifer calves are getting a good start, ideally doubling in weight before they are 2 months old, and then making sure they are adequately sized by breeding and calving age. First calf heifers in a grass-fed herd are more likely to struggle to have their energy needs met as they are growing and lactating, so having them well sized when they join the lactating herd will help them make more milk, and breed back on time.

Strategies to increase the amount of milk sold in total and per cow on a grass-fed dairy farm
(Continued)

- **Nutrition**
  - **Quality** - Forage quality must be high energy, so it needs to have digestible fiber in it. In this climate, this is mostly going to be early first cut which is then quickly dried to the ideal moisture content to be ensiled, then wrapped promptly so that air is excluded. Forage tests need to include fiber digestibility (NDFD30) to allow good decision making on which feeds will support high milk production in the grass-fed herd.
  - **Intake** – Increasing intake of high-quality forages makes it more likely that the high energy needs of the grass-fed cow can be met. In order for them to be able to eat more, it needs to be more digestible. In addition to improving digestibility, other methods to increase intake include chopping forages so the stem length is shorter, increasing head space per cow at the feeders, and providing them with bales that are palatable (smell and taste good to them).
  - **Access to water** in the pastures and at the barn and barnyard.
  - **Access to minerals**, preferably a loose correctly balanced mineral mixture without competition so that all cows are getting the correct amount of intake daily (loose is easier to eat enough of than just licking a block).
- **Dry cows and pre fresh cows** – extra attention to nutrition for this group of animals can help them calve in with fewer health problems, have a higher peak milk production in early lactation, and then go on to make more milk over their whole lactation.
- **Walking distance** – For the grass-fed herd, walking distance to pasture may sometimes be significant, and may include hills, road crossings and stream crossings. This can burn calories that would otherwise be available for them to make milk, and if the time spent walking is too long, can limit the time they have each day to eat, lay down, ruminate and all the other important daily cow activity.
  - Plan out grazing so there are pastures closer to the milking facility available to graze so they only have to walk to farther pastures once a day, and in hot weather only make that longer walk at night.
  - Add shade (trees) along lanes to reduce heat stress when walking.
  - Make improvements to lane surfaces to make walking easier and minimize hoof injury.

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