Deciphering Hay Quality

Mark Llewellyn

Ever notice that getting through the aisles of a grocery store is becoming a bit of a challenge? People can be found several feet, sometimes aisles, away from their abandoned shopping carts. While some of the missing patrons may be in hot pursuit of some forgotten fruit or frozen entrée, many are quietly reading. Reading what, you ask? The labels, of course. They're scouring the fine print on the side panels of boxes or the backs of bags to uncover the fat or carb content.

Horsemen are not exempt from this in-store reading. You'll see them in your neighborhood feed store, kneeling beside a bag of feed, looking for certain values. And when those numbers cannot be found, they are bound to call out: "What's the protein level in this feed?" "My horse is hotter than a firecracker. I need something with some fat in it!" "That old bay mare's showing her age—ribby and gray around her eyes. Do you have something with lots of fiber that's easy for her to chew?"

What's surprising about this is the fact that forage comprises at least half, and sometimes all, of a horse's diet. Yet hay comes with no labels, no tags, no guaranteed analysis. Scores of horsemen have valued sensory inspection over all else when selecting hay for their charges—whether they're backyard hacks or million-dollar athletes.

Eyeballing hay quality is the oldest and most common method of choosing hay. If asked what qualities they seek

when purchasing hay by sensory inspection, horsemen often list greenness, abundant leaves, lack of stems, and sweet fragrance with no trace of dust, mold, weeds or other debris. But are these seemingly simple parameters reliable? Color, for example, is not always an accurate indicator of hay quality. Bright green weeds could conceivably have a lower nutrient composition than yellowish-brown alfalfa.

More accurate than sensory appraisal is forage analysis. Currently, there are two methods of forage analysis, wet chemistry and near-infrared reflectance spectroscopy (NIRS). Some forage laboratories will offer one or both methods, though most will have to perform wet chemistry analysis to determine mineral content.

A common method of forage analysis involves the use of NIRS, which assesses the nutrient makeup of forages, identifying nutritional strengths and weaknesses. The major organic components of forages have specific absorption characteristics in the near-infrared region of the spectrum that make their identification and measurement possible. Forages can be analyzed in less than ten minutes. NIRS estimates forage composition accurately with the shortest turnaround time. From an economic standpoint, analysis by NIRS is usually less expensive than wet chemistry.

Forage analysis is imperative so proper supplementation in the form of concentrates can be offered. Executing a ration evaluation without knowing the nutrients the horse consumes in its forage is much like trying to piece together a jigsaw puzzle without having the box top, the desired image, on hand. Without a forage analysis, ration evaluation slides from science to guesswork.

Where Do I Start?

A list of forage-testing laboratories can be obtained from nearby feed companies or local Cooperative Extension Service offices. If inquiries at these places do not yield results, refer to the Web site of the National Forage Testing Association, www.foragetesting.org. This site features the contact information for nearly 100 laboratories. Once you have found a laboratory that will provide the testing you require, ask for instructions on how a sample should be prepared.

Without a doubt, the laboratory will request a representative sample of hay, as results will be of limited value if the sample is not an accurate portrayal of the hay intended to be fed. Therefore, appropriate sampling technique is vital. Each "lot" of hay should be sampled separately. A lot is defined as hay harvested on a single occasion from the same field, involving the same species of plants and subject to the same environmental conditions during harvest and storage. When sampling small square bales, 15 or 20 should be chosen from the lot. These should not be the most desirable bales based on sensory evaluation, but randomly chosen ones.

Hay samples must be taken from each bale using a hay probe or corer. The instrument is usually 12 to 24 inches long and at least 3/8 to 3/4 inches in diameter. The tube is hollow, creating a reservoir for the sampled hay. Old-fashioned probes are manipulated with a hand auger, but more modern ones attach to an electric drill. The sample should be taken from the center of the bale from short end to short end. Obviously, the probe is much shorter than the bale, but the probe should be driven into the bale as far as it will allow.

Repeat the procedure on all of the chosen bales. When the tube becomes full of hay, remove it using a dowel plunger, which is often included with the purchase of the hay probe. Place the hay particles or drillings into a clean container. Once collection is finished, mix the samples in the bucket thoroughly to produce a composite. Then, package the sample according to the laboratory's instructions. Most laboratories ask for a sample that weights 3/4 to one pound. Be sure to complete the form provided by the laboratory and send it with the sample.

The Penn State Forage Sampler, an 18-inch, stainless steel hay probe, has a sharp, serrated tip that facilitates easy cutting through loosely or tightly bound bales. Like many other models, an adapter allows the Penn State Forage Sampler to be used with a drill or a hand brace.

Interpreting the Analysis Report

At first, the forage analysis will look like a bunch of jumbled figures. A few key numbers will help determine if the hay is providing sufficient nutrients to horses. There are usually two columns of numbers, one labeled "dry matter" and another labeled "as fed." The "as fed" column is more useful to the horse owner because it tells what nutrients the horse actually derives from the hay. The "dry matter" values are derived from the same sample but only after drying.

Moisture—The moisture content of hay is an indicator of the effectiveness of the harvesting process as well as the quality of the finished product. Most hays are around 10% moisture. Hay with moisture greater than 13% may at the least be unpalatable to horses, and at the worst may be susceptible to mold proliferation, which can lead to an array of health problems.

Crude protein (CP)—CP indicates only the level of amino acids and total nitrogen in the forage. This is not an indication of energy availability, but is intended to be an estimate of the protein in the hay. Protein content of hay varies considerably; in some high-quality legume hays, protein content can reach 20% or more. Many horsemen would be surprised to see that fresh pasture on a dry matter basis can go as high as 26%. Mature grass hay, on the other hand, would likely be on the opposite end of the spectrum at less than 8%, though top-quality grass hays can top out at 12% protein. Even though it is not uncommon to see a timothy hay with about 6% protein, a respectable grass hay should have at least 8% protein.

Digestible energy (DE)—DE is an estimate of the amount of calories available to the horse. It is derived by an equation using values of other nutrients and their known relationship for energy production. Look for "Horse DE" because the value for other livestock will be different. The DE of a hay depends largely on the stage of maturity at harvest. Young hay harvested at the beginning of the growing season will be higher in DE. As plants age in the field, the lignin content increases, reducing the digestibility of the plant and leaving fewer calories available for the horse. Any hay with a DE of less than 0.75 Mcal/lb should not be fed to horses because the indigestibility can make the horse more susceptible to impaction colic.

Acid detergent fiber (ADF)—Composed of cellulose and lignin, ADF reveals the digestibility of nutrients in the hay. The digestibility of cellulose varies, but high amounts of lignin have an adverse effect on the digestibility of cellulose. Therefore, the higher the ADF, the lower the digestibility of the nutrients in the hay. Hays with ADF levels above 45% have little nutritive value. Conversely, hays with ADF levels lower than 31% are excellent.

Neutral detergent fiber (NDF)—NDF represents all the nutrients that make up the cell wall (structural carbohydrates), both digestible and indigestible. The more NDF in a plant, the less room for other digestible nutrients such

Quality Counts

The Hay Market Task Force of the American Forage and Grasslands Council (www.afgc.org) classifies forages using a quality scale. The standards apply to legumes, grasses, and legume-grass mixtures. By comparing the values reported by the analysis received from a reputable laboratory with those in the table below, you'll see how your hay rates. A quality standard score of "prime" is the most desirable, whereas a score of "5" is least desirable. Where does your hay fall?

Quality standard	Crude protein (CP)	Acid detergent fiber (ADF), % of DM	Neutral detergent fiber (NDF)	Relative feeding value
Prime	> 19	< 31	< 40	> 151
1	17 – 19	31 – 35	40 – 46	151 - 125
2	14 – 16	36 – 40	47 – 53	124 – 103
3	11 – 13	41 – 42	54 – 60	102 – 87
4	8 –10	43 – 45	61 – 65	86 – 75
5	< 8	> 45	> 65	< 75

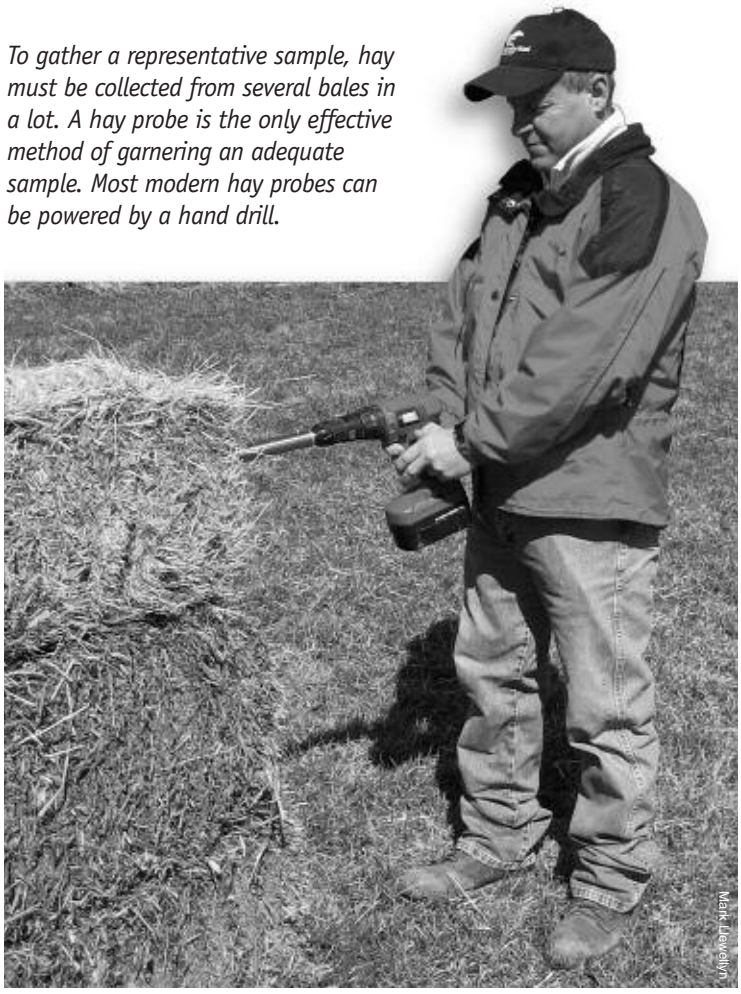
as protein, sugars, and starches. Hays with NDF values below 40% are excellent, and those hays with a NDF of 65% or greater will likely not be eaten by most horses.

Relative feed value (RFV)—A high RFV reflects higher quality, greater intake, and higher digestibility. Thus, fewer concentrates will be needed to supplement the diet. RFV should be a principal consideration when purchasing horse hay. For a more complete explanation of RFV, see the sidebar titled "The Importance of Relative Feed Value."

Minerals and vitamins—The most common macrominerals tested in a forage sample are calcium, phosphorus, magnesium, potassium, and sodium, while some microminerals assayed include iron, zinc, copper, and manganese. Analysis for microminerals may be costly but important for balancing the total diet. The micromineral selenium, for instance, is expensive to analyze for and is not commonly included in a forage analysis.

To have an analysis of vitamins performed is also an expensive prospect; such testing is not usually completed by forage testing stations but by specialty labs.

Forage represents a significant portion of a horse's diet. Equine nutritionists need to know the nutritional composition of hay in order to successfully formulate or balance a ration for a horse. Therefore, for fine-tuning a horse's diet, analysis of forages is imperative.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To gather a representative sample, hay must be collected from several bales in a lot. A hay probe is the only effective method of garnering an adequate sample. Most modern hay probes can be powered by a hand drill.


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The Importance of Relative Feed Value

A hay broker sets three bales of hay in front of you. Each is broken open to reveal its interior. The hay that comprises the bale on the left is brown and coarse. As you grab a handful of the hay, a cloud of dust escapes from the bale and a moldy aroma fills the air. But the hay that makes up the remaining two bales is bright green, laden with soft leaves, and smells as if it were baled the previous afternoon. Without data on the nutrient content of the forage, it may be impossible to tell which of the green hays is most desirable for the horses in which it will be fed. With an RFV reading, however, it is simpler to distinguish the best deal.

The Hay Marketing Task Force of the American Forage and Grassland Council endorses relative feed value (RFV) as a measure of forage quality. RFV is calculated by combining the digestibility and intake potential of forages into one number. Acid detergent fiber (ADF) is negatively correlated with digestibility (the greater the number, the lower the digestibility), and neutral detergent fiber is negatively correlated with intake (the greater the number, the lower the intake). Thus, forages with a high ADF and a high NDF will have a low RFV because the ability of an animal to meet its nutrient requirements from the forage is minimal.

An average-quality hay would have an RFV of 100, one less than average would have an RFV of less than 100, and better than average more than 100.

Remember, RFV can be generated only from analyses that report both the ADF and NDF, as both values are essential in determining RFV.

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