



Introduction

Most universities and equine nutritionists encourage horse owners to have their hay or pasture analyzed, especially if the

quality of hay is a concern, or the horse is having nutritional problems. However, most horse owners need help interpreting the results of their analysis. Below is a list of some common components analyzed in hay, and a basic interpretation of each; keep in mind that additional components can be analyzed for by request and/or for an additional cost.

When your sample is returned, there will be two columns of numbers; *As Sampled* and *Dry Matter*. *As sampled* reports nutrients in their natural state, this includes moisture. *Dry matter* reports nutrients with the water (moisture) removed. Results reported as *dry matter* allow for the direct comparison of nutrients across different feeds and often simplifies the ration balancing process. Either can be used for ration balancing, but it's very important to be consistent and use one or the other.

- **Moisture:** the optimum horse hay moisture ranges from 10 to 15%. Hay under 10% may be too dry, leading to brittle and dusty hay. Hays over 17% moisture have a high probability of molding (unless propionic acid is used), and hays over 25% moisture pose the threat of severe heat damage and serve as a potential fire hazard.
- **Dry Matter (DM):** amount of the sample is left after the water (moisture) is removed.
- **Crude Protein (CP):** a measure of the protein concentration in the hay. CP can range from 8 to 14% in grass hays (depending on nitrogen fertilization), 14 to 17% in mixed hays, and 15 to >20% in legume hays. Hay containing approximately 10% CP meets the CP

requirements of most horses, lactating mares and foals being the exception.

- **Acid Detergent Fiber (ADF):** ADF primarily represents cellulose and lignin, the highly indigestible fractions of plant material. The lower the ADF value, the more digestible the nutrients in the hay are. Hays with ADF values of 30 - 35% are readily digested, while those above 45% are appropriate for feeding horses with lower energy needs.
- **Neutral Detergent Fiber (NDF):** NDF is a measurement of the insoluble fiber, including hemicellulose, cellulose, ligno-cellulose, and lignin. These components are classified as cell wall or structural carbohydrates, and provide the plant with structural rigidity. The higher the NDF, the less a horse will consume. NDF levels between 40 and 50% are good, while those above 65% will likely not be readily consumed by most horses, but can be used as "busy hays" to pacify obese horses on restricted feed.
- **Relative Feed Value (RFV) or Relative Forage Quality (RFQ):** RFV and RFQ are commonly used when selecting quality dairy hay, but are not used in balancing equine rations. However, RFV and RFQ can be used as a guideline in identifying quality hay. Generally speaking, higher RFV and RFQ reflect higher quality, greater intake, and digestibility.
- **Fat** (sometimes referred to as Crude Fat): is a measure of fat content. Fat is an energy dense nutrient and contains about 2.25 times the energy found in carbohydrates. Forages are typically low in fat.
- **Non-fiber Carbohydrate (NFC):** a mathematical estimate of starches and sugars. Although not always perfect, the NFC value is often used as an indicator of the level of starches and sugar in a forage sample.
- **Equine Digestible Energy (DE):** Measure of the digestible energy in the hay and is used to balance the energy portion of the equine diet. For a light working horse, DE intake should be approximately 20

Mcal/day; most hays range from 0.76 to 0.94 Mcal/lb of DE.

- **Equine Total Digestible Nutrients (Equine TDN):** This is a measure of the total digestible nutrients in the hay or its energy value (may be used in place of DE, or offered in addition to DE), which may range from 40 to 55%.
- **Calcium (Ca) and Phosphorus (P):** These two macrominerals are required in the diet by all horses in specific amounts. The levels of these minerals can vary among different types of hay, for example legume hays have high calcium levels relative to phosphorus. For the adult, maintenance horse, the Ca:P ratio should be between 3:1 to 1:1.
- **Potassium (K):** is an electrolyte. Legume forages are higher in potassium than grasses. Since hay is generally high in potassium, and usually constitutes a significant portion of the equine diet, potassium requirements are usually met with hay alone.

Forage Carbohydrates

Recently, there has been significant interest in the sugar and carbohydrate content of hays. The below analyses can be very useful in selecting a suitable feed for horses, especially those that show sensitivity to carbohydrates. Some labs test for the following (note there may be an additional charge for these services):

- **Non-fiber Carbohydrate (NFC):** discussed above.
- **Non Structural Carbohydrates (NSC):** an analysis of the non structural carbohydrates (starches and sugars) in the forage. Not to be confused with NFC, which is estimated, not measured directly. Sometimes, NSC is estimated by adding starch plus either WSC or ESC. Since some horses can be very sensitive to dietary starch and sugar (*i.e.* horses with Cushing's disease, PSSM, or laminitis), the NSC level can be helpful in selecting hay. Hay containing greater than 10% NSC should not be fed to these horses.

- **Starch:** is a good source of energy. However, no more than 15% of total daily calories from starch should be fed to horses diagnosed with PSSM (polysaccharide storage myopathy).
- **Ethanol Soluble Carbohydrates (ESC):** carbohydrates solubilized and extracted in 80% ethanol. Includes primarily monosaccharides (glucose and fructose) and disaccharides. Some forage labs will refer to ESC simply as "Sugar".
- **Water Soluble Carbohydrate (WSC):** carbohydrates solubilized and extracted in water. Includes monosaccharides, disaccharides and some polysaccharides (mainly fructan). Fructan is a major storage carbohydrate in grasses.

Subtracting WSC from ESC will give a rough estimate of fructan. Use only with cool season grasses. Fructans is a complex sugar correlated with laminitis.

Balancing Your Horse's Ration

Once your hay has been analyzed, work with an equine nutritionist to balance your horse's ration. Generally speaking, a horse's ration is balanced in the following order: energy (with a focus on fiber), protein, minerals, and vitamins. To read the latest recommendations on equine nutrient requirements, consult the National Research Council's *Nutrient Requirements of Horses* publication.

DHIA Stearns Co. (320-352-2028), Dairyland (320-240-1737), and Equi-Analytical (877-819-4110) can test hay for the above components and have an equine equation. Contact the lab of your choice prior to sending in the sample to obtain their recommended sampling procedures, costs, and components analyzed for. Be sure to request an equine analysis, and remember that the analysis is only as good as the sample you submit. For information on how to correctly take a forage sample, see *Sampling hay, silage, and total mixed rations for analysis* (UW-Extension fact sheet A2309; September 2005).

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