



# Sensory Evaluation of Hay for Quality

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Choosing or producing quality hay can be one of the most important economic considerations for livestock managers. Any nutrients not supplied by forage have to be supplemented by concentrates which increases the total feed bill for the operation. High quality hay has high nutrient content (crude protein, digestible energy, and minerals), high intake potential and high palatability. Quality hay should be low but adequate in fiber content, free of dust, musty odor, detrimental weeds, and excessive foreign material.

The most reliable approach for evaluating hay for quality is a combination of physical/sensory inspection combined with chemical analysis (forage testing). Unfortunately, chemical analysis is not always feasible or cost effective. Even with a forage test, it is good to have the sensory skills in evaluating hay to make sure the forage test reflects the actual quality of the hay.

## Factors That Affect Forage and Hay Quality

Hay varies in quality more than any other harvested feed; therefore, having an understanding of the factors that affect this variation is important for making skillful evaluations. Most of these factors apply to many of the different plant species that are grown and utilized for hay. We will mainly focus on the most common hay species used in Vermont including alfalfa, red and white clover, and perennial grasses such as orchardgrass, reed canarygrass, tall fescue, timothy and smooth brome grass. Other less desirable grasses sometimes found in Vermont hay include Kentucky bluegrass, poverty grass, and fine fescues. The following are the major factors that influence quality and should be taken into account when evaluating hay for quality.

**Stage of Maturity** - The stage of plant development at the time of harvest is considered one of the most important and influential factors affecting quality. This factor sets the upper limit of quality and all other factors can only subtract from this quality level. Determining the stage of maturity is easier before the stand is cut; evaluating the maturity of baled hay can be challenging and takes practice. The stage of maturity of **alfalfa hay** can be estimated by noting the presence of buds and flowers, texture and woodiness of the stems, and level of leafiness. When cut in the bud stage, you should find no flowers and the stems are relatively fine and pliable. The presence of purple flowers, somewhat larger stems but no seed pods indicates early bloom stage. Large stems with few leaves and especially the presence of seed pods indicates late maturity. Quality of alfalfa cut at the same stage of maturity will be different for first, second, and subsequent cuttings, necessitating that stem quality and leafiness be included in the evaluation criteria.

**Clover hay** maturity can be determined by observing both the color and condition of its blooms and heads. Clover cut in early bloom usually has numerous red or purplish-red blossoms (red clover) or pinkish-white to white blossoms (white or alsike clover). Brown clover heads and yellowish-brown seeds indicate full bloom and dark brown heads with plump, mature seeds indicate full maturity. Do not rely on seed alone since first cut clover often does not produce seed. **Grass hay** maturity is determined by examining the number and state of seedheads.

Unless cut extremely early, first cutting grass hay will usually have numerous seed stalks (called

"culms"). Early cut grass would be in the boot (no visible seedhead) or early head emergence stage. If much of the grass is in full head stage, it is helpful to determine if it is early-head or late-head. Early head stage is just after head emergence but before the grass actually flowers. Late head is often associated with plump brown seeds that shell out easily from whitish glumes or chaff. Seedheads and stems of more mature grass often have a yellowish brown color.

**Leafiness** - Leafiness relates to the relative proportions of leaves to stems in the hay and is important since the majority of digestible energy, protein minerals and vitamins are found in the leaves of forage plants. Leafiness is influenced by both harvest/handling methods and stage of maturity. As legumes and first cutting grasses advance in maturity, stem mass increases proportional to their leaves, lower leaves die and fall from the plant; as a result the leaf-to-stem ratio declines. Even hay harvested at earlier stages of development can have low leaf-to-stem ratios if the hay was not handled or harvested properly. Leafiness of legume hay is particularly critical since they lose their leaves during curing and handling more easily than grasses. Leafiness of legume hay can vary from 65 to 70 percent for very leafy, to as low as 10 to 15 percent for very stemmy hay. When evaluating a bale of hay, it is important to break the bale open and look for detached leaves. Depending on the care of handling and how the hay is fed, detached leaves may or may not be utilized by the animal eating the hay. If the hay is ground and fed in a total mixed ration or if the hay is fed in a manger, most all of the leaves may be utilized. However, if the hay is fed on the ground, most of the detached leaves will drop and be wasted.

**Color** - Hay with a bright green color usually indicates that the hay was cut at a relatively early stage of maturity; rapidly and properly cured, with no damage from rain, molds, or overheating during storage. However, a lack of bright green color does not mean the quality of the hay is necessarily poor. In fact, an early cut, rain damaged hay that is off-color may have a higher quality than a bright green late cut hay. There are different reasons why hay loses its green color, some more detrimental to quality than others. As discussed above, **over-mature grasses** often have stems and seedheads that are golden yellow to yellow. **Bleaching** caused by sun exposure forms a whitish to whitish-yellow color and usually does not decrease the quality of the hay nearly as much as rain or heat damage. Bleached hay will have less carotene in it, but protein and energy content are not usually affected. Sun bleached hay is usually not found throughout an entire bale since bleaching usually occurs on the outside surface of the windrow before baling; most the remainder of the hay should still be green. Bales exposed to the sun can also become bleached on their surface, which is another reason to open up a bale when making an evaluation. **Rain damaged** hay has a characteristic dark brown or black appearance. The affect of rain on nutrient content of hay depends on when the rain occurred after cutting and on the intensity and frequency of rain. However, you can usually assume that the extent of rain damage that caused dark brown color throughout the hay has caused a significant reduction in quality. **Heat damage** of hay occurs when the hay is baled and stored too wet causing excessive heat from microbial (mold) growth. Usually this is also associated with a musty, moldy odor and visible signs of mold such as flakes of hay caking together.

**Odor and Condition** - A fresh aroma, free of must and mold, is often associated with green, well cured hay. Usually this hay will be more palatable. Dustiness and musty or moldy smells can reduce palatability and indicate other quality problems. They are often associated with rain damage or poor storage conditions.

## Guidelines for Grading Hay<sup>1</sup>

The score sheet below is a guideline for evaluating hay. The sheet indicates the amount of importance to place upon each quality factor. Note that maturity, at 30 points, is the most important factor. Leafiness, color, and odor and condition each receive a possible 20 points. Foreign material has a possible 10 points.

Factor	Description	Possible Score
<b>Stage of Maturity of the Forage</b>	When visually appraising hay for maturity, try to estimate the average maturity of the bale, not the most mature stalk in the bale. Consider the maturity all the species in a mixed hay.  <u>Legumes (Alfalfa, Clover, Birdsfoot Trefoil)</u> Bud stage or earlier                      26 - 30 Early bloom                                      20 - 25 Late bloom                                        10 - 19 Seed stage or later                              0 - 9 <u>Grasses</u> Pre-boot stage                                    26-30 Boot stage                                         20-25 Early head                                        10 - 19 Full head or greater                              0 - 9	30
<b>Leafiness (Leaf to stem ratio)</b>	Leafiness relates to both maturity and harvest factors that affect leaf shatter. Some guidelines: High leafiness with attached leaves                      18 - 20 High leafiness with many detached leaves                      13 - 17 Moderate leafiness    6 - 12 Stemmy hay and/or hay with shattered leaves                      0 - 5	20
<b>Color</b>	Color is influenced by many factors: Hay with a bright green color                      18 - 20 Bleached hay on surface or only part of hay                      11 - 17 Golden yellow to yellow throughout                      6 - 10 Dark brown or black hay (rain damage)                      0 - 5* Brown hay (heat damage)                              0 - 5*	20*
<b>Odor and Condition</b>	Smell of new mown hay                              15 - 20 Musty or other off-odors                              0 - 10 Moldy or unusually dusty hay                              0 - 5*	20*
<b>Foreign Material and Weeds</b>	Free of any foreign material                              10 Few to some weeds                                      5 - 9 Unpalatable or mature weeds                              0 - 4 Other foreign material                                      0 - 5*	10*
<b>Total</b>		100

\*So poor or injurious that hay may be totally unacceptable for animal feed

<sup>1</sup> Adapted from Vough, L.R. Evaluating Hay Quality. Maryland Coop. Ext Fact Sheet 644

**Quality Categories** - By accounting for the various quality factors described in the score sheet on page 3, hay can be assigned into five quality categories - excellent, high, good, fair, and poor. The following table provides an estimate of the nutritional value of hay according to the sensory score and quality category. Grasses vary from legumes and grass/legume mixtures usually fall in between these levels depending on the proportion of each component.

The quality of hay you need depends on the needs of your particular animals. Excellent to high quality hay would be appropriate for lactating or finishing animals. Fair to good hay could serve the needs of dry cows, maintenance animals or pleasure horses. Poor quality hay may still be useful for some livestock classes if fed in small quantities unless it has mold or injurious materials that could cause harm. Keep in mind that many factors affect quality, so the estimated values in this table are not meant to substitute for a forage test.

<b>Total Score</b>	<b>Category</b>	<b>Grass Nutritional Value*</b> <b>CP – ADF – NDF - NEL</b>	<b>Legume Nutritional Value*</b> <b>CP – ADF – NDF - NEL</b>
96 - 100	Excellent	18 – 30 – 50 – 0.75	20 – 30 – 40 – 0.68
90 - 95	High	16 – 32 – 55 – 0.70	18 – 32 – 42 – 0.61
80 - 89	Good	14 – 36 – 60 – 0.65	16 – 35 – 46 – 0.59
70 - 79	Fair	11 – 40 – 65 – 0.60	14 – 38 – 50 – 0.56
Below 70	Poor	<9 – >50 – >73 – <0.45	<10 – >40 – >52 – <0.53

\* Expressed on a dry matter basis CP (%) – crude protein; ADF (%) – acid detergent fiber; NDF (%) – neutral detergent fiber; NEL (Mcal/lb) – net energy of lactation

### **Forage Quality Terms**

Crude Protein (CP) - Crude protein includes both true protein and non-protein sources of N and is determined by measuring the total nitrogen content of the forage times 6.25.

Acid Detergent Fiber (ADF) - This value refers to the cell wall portions of the forage that are made up of cellulose & lignin. These values are important because they reflect the ability of an animal to digest the forage. As the ADF increases, digestibility of forage decreases along with the energy. On a forage test, ADF is used to calculate total digestible nutrients and net energy of lactation (NE<sub>L</sub>).

Neutral Detergent Fiber (NDF) - This value is the total cell wall content which is comprised of the ADF portion plus hemicellulose. These values are important in ration formulation because they reflect the amount of forage the animal can consume (intake). As NDF increases, dry matter intake (DMI) will decrease. DMI as a % of body weight = 120/NDF.

Net Energy Lactation (NE<sub>L</sub>) - The energy value of the feed for milk production, expressed as megacalories (Mcal) per pound of feed. It is calculated from the ADF of the feed. Different forages use different equations to determine NEL, therefore correctly identifying forages is important (i.e. grass, mixed grass/legume, or legume).

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