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Garry D. Lacefield
University of Kentucky, garry.lacefield@uky.edu

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ALFALFA HAY QUALITY MAKES THE DIFFERENCE
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Garry D. Lacefield
Department of Agronomy

Alfalfa "Queen of the Forage Crops" is one of the most important forage legumes grown in the US. It can be grown over a wide range of soil and climatic conditions, it has the highest yield potential and the highest feeding values of all adapted perennial forage legumes. Alfalfa is a versatile crop which can be used for pasture, hay, silage, green-chop, soil improvements and human consumption (sprouts, etc.).

Alfalfa Hay Quality

The ultimate test of alfalfa hay quality is animal performance. Its quality is considered satisfactory when animals consuming it perform as desired. Whether you are buying or selling, producing or feeding, "quality" should be a major consideration. Three quality factors influence animal performance:
1)Consumption--Because hay intake is a major factor in animal productivity, hay must be low in fiber and palatable for the animal to consume enough of it.
2)Digestibility and Nutrient Content--Once hay is consumed, it must be digested if it is to be converted to animal products.
3)Anti-Quality Components--High quality hay must be free of components harmful to animals.

Factors Affecting Quality

Factors which affect alfalfa hay quality include: growing conditions, harvesting, curing, handling, storage, fertility, varieties, pests and presence of other plant species. However, the stage of maturity when harvested is the most important factor, and the one where management can have the greatest impact. As alfalfa plants advance from the vegetative to reproductive stages, then fiber and lignin increase, and protein, digestibility, metabolizable energy and acceptability to livestock all decrease (Table 1). Early cut hay makes a more desirable feed because it contains more of the nutrients associated with high quality. Hay cut at an early stage of maturity is also more palatable and is consumed in larger quantities by livestock. Thus, using early cut hay improves animal performance and reduces the amount of late cut hay needed.

Table 1.--Relationship of the Stage of Alfalfa Maturity at Harvest to Total Digestible Nutrients (TDN), Crude Protein (CP) and Acid Detergent Fiber (ADF).*

Maturity	TDN (%)	CP (%)	ADF (%)
Pre-bud	65	21.7	28
Bud	62	19.9	31
1/10 bloom	58	17.2	34
1/2 bloom	56	16.0	38
Full bloom	54	15.0	40
Mature	52	13.6	42

SOURCE: Nutrient Requirements of Dairy Cattle, 1978, National Academy of Science, Publ. 1349
*Expressed on dry matter basis.

Evaluating Hay Quality

Several methods exist for evaluating alfalfa hay quality: visual, chemical, Near Infrared Reflectance Spectroscopy (NIRS) and animal performance. Visual estimates can help, but evaluators vary

considerably. Description based on these estimates show high quality hay to be early cut, green, leafy, soft, free of foreign material and with a pleasant odor.
The most precise way to determine hay's nutrient content is through quality analysis. If you take a representative sample and have its quality analyzed, the results can help you determine how much and what type of supplementation to use for the level of animal performance you want. Determining hay quality also lets you meet the nutrient requirements of different classes of livestock which can lead to more efficient and economical feeding programs.

Sampling for Quality Tests
To test your hay you must get a random, representative sample because the laboratory results will be only as accurate as the sample submitted. Take samples for each "lot" of hay. A lot of hay is hay taken from the same harvest, the same field, same type of harvest conditions, and with the same method of storage and same weather conditions during harvest.

Collecting the Sample
When collecting samples:
1)use a hay probe with minimum cutting diameter of 1/2 inch and minimum length of 12 inches (several hay probes are available commercially at prices ranging from $28 to $100);
2)take samples from the end of bales;
3)submit 15 to 20 probe samples from each "lot" of hay;
4)store samples in an airtight bag for shipment to laboratory (otherwise moisture content will change);
5)when using a probe with an electric drill, use slow speed only (high speeds heat the sample and can change composition or moisture);
6)avoid sending "grab" samples or flakes of hay.

Methods of Analysis
Traditionally, laboratories received samples and, through several chemical laboratory tests, completed a quality analysis on them. Most laboratories still use this method but many are using a newer more rapid method called NIRS.
NIRS (Near Infrared Reflectance Spectroscopy), developed in the mid-70s as a research tool, has been used widely since the early 80s for forage quality evaluation. NIRS is a rapid, accurate, repeatable, low-cost and nondestructive method. Samples needing days to be analyzed with traditional laboratory tests can be analyzed in minutes using near infrared light.
How does NIRS work? Each major organic component of forage (e.g. protein) absorbs and reflects near infrared light differently. By measuring these different reflectance characteristics, the NIRS and its coupled computer can rapidly determine the quantity of these components in the forage. Thus, NIRS analysis offers many opportunities in conjunction with ration balancing programs.
NIRS is also quite mobile. All the necessary equipment can be put in a van and moved for on-site analysis. These mobile vans can also be involved in marketing alfalfa hay. With NIRS, the quality of a lot of hay can be determined before the sale, so both buyers and sellers will know its feed value. This technology is rapidly improving inter- and intra-state communications within the hay marketing industry and offers tremendous potential for creative electronic marketing.
Quality Standards
Many groups and organizations (American Forage and Grassland Council, National Alfalfa Hay Testing Association, National Hay Association, etc.) have worked together over several years to develop standards based on quality analysis. Table 2 gives the most recent standards proposed.

Table 2.--Legume, Grass and Legume Mixture Quality Standards

Quality Standard[a]	Analysis[b]					
	CP	ADF	NDF	DDM[c]	DMI[d]	

	% of DM			%	% of BW	RFV[e]
Prime	> 19	<< 31	<< 40	> 65	> 3.0	> 151
1	17-19	31-35	40-46	62-65	3.0-2.6	151-125
2	14-16	36-40	47-53	58-61	2.5-2.3	124-103
3	11-13	41-42	54-60	56-57	2.2-2.0	102-87
4	8-10	43-45	61-65	53-55	1.9-1.8	86-75
5	<< 8	> 45	> 65	<< 53	<< 1.8	<< 75

[a]*Standard assigned by Hay Market Task Force of AFGC.*

[b]*Analysis associated with each standard; CP = crude protein, ADF = acid detergent fiber, and NDF = neutral detergent fiber.*

[c]*Digestibility dry matter (DDM, %) = 88.9 - 0.779 ADF (% of DM).*

[d]*Dry matter intake (DMI, % of body weight) = 120/forage NDF (% of DM).*

[e]*Relative Feed Value (RFV) calculated from (DDM X DMI)/1.29. Reference hay of 100 RFV contains 41% ADF and 53% NDF.*

Quality and Animal Performance

Research studies with varying qualities of alfalfa hay fed to different classes of animals have conclusively shown that the final and best test of quality is animal performance. High quality hay results in better animal performance. It also reduces the need for supplementation. Table 3 shows results of studies in Wisconsin relating quality factors to milk production. Tennessee studies (Table 4) show the effect of alfalfa hay quality on beef gains.

Table 3.--Estimated Grade, Average Concentration of Crude Protein (CP), Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF) and Milk Yield in Wisconsin,* 1984-1986.

Estimated Grade	Number of Cuts	CP %	ADF %	NDF %	Milk lb/A
Prime to 1	5	22	31	43	10,688
No. 1	4	21	32	44	9,120
No. 1 to 2	3	19	35	46	7,022
No. 2	2	17	36	48	4,259

SOURCE: Adapted from D.A. Rohweder et al., University of Wisconsin.
**Wisconsin Forage Council Green Gold Project, 1984-1986.*

Table 4.--Effect of Alfalfa Hay Quality on Performance of 550 Lb Beef Steers.

Hay Quality	Good	Fair	Poor
Crude Protein	18.7	15.9	13.7
Crude Fiber	29.4	35.4	46.7
Animal Performance			
Hay consumed, lb/day	17.1	16.5	13.8
ADG, lb	1.85	1.49	-0.06

SOURCE: University of Tennessee

Buyers who know and appreciate hay quality are usually willing to pay more for a quality product. At hay auctions in Wisconsin (Table 5) buyers paid a premium for higher quality hay.

Table 5.--Avg Price/Ton by Grade in Wisconsin Quality Tested Hay Auctions (2 year avg 1807 Lots).

Grade	Maturity	Price/Ton
Prime	Bud	$117
1	E. Bl.	103
2	M. Bl.	79
3	F. Bl.	68
4	P. Bl.	65
5	*	63

SOURCE: Adapted from D.A. Rohweder, University of Wisconsin.
**Post-bloom, grass, weathered.*

Summary

Traditionally, major emphasis has been given to the production of high yields of alfalfa hay. Over the last 10 or so years, greater emphasis has been placed on producing high quality hay. Considerable advances have been made in production, and progress is being made relative to quality. Although advances have been made, much is yet to be learned and implemented from both buyer's and seller's perspective to more fully understand and appreciate hay quality's importance.
Horse and dairy markets have demanded, and will continue to demand, high quality hay. Consequently, in planning a production and marketing strategy, one should set a goal for high quality hay production. This goal requires more intensive management, because even a few days' delay in cutting will result in lower quality due to advancing maturity. Even if you set a goal of only-high-quality hay, considerable quantities of medium to low quality hay may be produced during the haying season due to factors beyond your control (weather, pests, equipment breakdown, etc.).
For hay producers in the feed some-sell some situation, a system of selling the best hay and feeding the rest permits efficient utilization. Producers who have no livestock and are sell-all marketers must work out a strategy for utilizing the lowest quality, damaged hay and broken bales. Many producers have worked out arrangements with neighbors who have cattle operations that can use that part of their product.
Likewise, individuals and groups who buy and feed alfalfa hay must become more quality conscious. Knowing what influences quality and what impact it has on animal performance helps you develop more efficient and economical feeding programs.

Glossary

CRUDE PROTEIN (CP) is the concentration of a mixture of true protein and nonprotein nitrogen. CP equals nitrogen x 6.25 and indicates the capacity of the feed to meet an animal's protein needs.
DRY MATTER (DM) is the percentage of the feed that is not water. DM equals 100% minus percent water.
NEUTRAL DETERGENT FIBER (NDF) is an estimate of the percentage of cell wall material or plant structured material in a feed. Measurement of this constituent is important because it is only partially available to animals. The lower the NDF percentage, the more of that hay an animal will eat. Thus, a low percentage of NDF is desirable. NDF also includes acid detergent fiber and is inversely related to intake.
ACID DETERGENT FIBER (ADF) is an index of the percentage of highly indigestible plant material in a feed or forage. This constituent is insoluble in acid detergent. ADF differs from crude fiber in that ADF contains silica. Silica and lignin in plants are associated with low digestibility. The lower the ADF,

the more feed an animal can digest. Thus, a low ADF percentage is desirable.

DIGESTIBLE DRY MATTER (DDM) is an estimate of the percentage of the feed or forage that is digestible, based on feeding trials with animals and also determined from ADF concentration.

DRY MATTER INTAKE (DMI) is an estimate of the relative amount of forage an animal will eat. It is based on animal feeding trials and NDF concentration.

DIGESTIBLE DRY MATTER INTAKE (DDMI) is an estimate of how much DDM an animal will consume. DDMI also estimates digestible energy intake (DEI). DDMI is calculated by the equation DDM x DMI/100.

RELATIVE FEED VALUE (RFV) compares one forage to another according to the relationship DDM x DMI/100 divided by a constant.