NEWS TO EWES

A Hay for Every Season

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Introduction

Webster's New Collegiate Dictionary and the internet has the same definition of **Hay. Both sources say it is herbage, and especially grass, mowed and cured for fodder**. Fodder is coarse feed for cattle, horses, sheep, and goats. This broad definition allows for many descriptions of hays, probably as many as there are types of hays. For example, I have heard hay called legume, grass, grass-legume, good, sorry, low-quality, medium-quality, high-quality, stemmy, leafy, bright, bedding, bed and breakfast (Figure 1), sheep, cattle, goat, weedy, moldy, wet, rained on, tobacco, and dusty. There is a connection attached to each of these descriptions. That is, each description relates, either directly or indirectly, to the quality of the hay.

Figure 1. Bed and Breakfast Hay

Hay Quality

The first factor that affects hay quality is **palatability**. Sheep are superb evaluators of hay quality. If they readily consume it, it is high-quality. If they use it for "bed and breakfast", it is low-quality. Hay consumption depends on its smell (sweet vs. musty), feel (soft vs. hard), and taste (sweet, sour, or salty). Animals must consume their allotted amounts if they are to perform to the producer's goal(s). **Intake** of palatable, high-quality hay will always be greater than lower quality, which will allow producers a better chance of achieving the goal(s) they have set for their animals. **Digestibility** is the extent to which complex chemical compounds (protein, starch, cellulose, hemicellulose, minerals, and vitamin complexes) of the consumed hay dry matter are reduced to simple compounds in the digestive tract so they can be absorbed into the blood for use by all body cells. Leafy hay, harvested in the vegetative stage of maturity, can be 80 to 90% digested and absorbed. On the other hand, allowing this same forage to become mature and "stemmy" will result in a hay that may be only 40 to 50% digested and absorbed. In the latter case, 50 to 60% of the components (protein, starch, cellulose, hemicellulose, minerals, and vitamins) of the consumed dry matter passes out of the digestive tract, as feces, without providing any benefit to the animal.

Nutrient Content

The nutrients in hay are all located in the dry matter. This usually makes up 85 to 92% of every bale. The dry matter is made up of either plant cell contents (center of each cell) or structural components that make up each cell wall. The cell contents (nonstructural components) include protein, sugars, and starch. Sugars and starch provide energy. Higher quality hays contain a higher percentage of cell contents and typically are a brighter, greener color than those that are lower quality. The structural components (cell walls) contain cellulose, hemicellulose, and lignin. These provide energy, too, but less than sugars and starch. When grouped together, they are the "fiber" component of plants (neutral-detergent fiber = NDF and acid-detergent fiber = ADF). These "fiber" components are less digestible than the cell contents; thus, lower quality hays are harvested when forages are mature and stemmy. These hays contain higher

percentages of cell wall components and will have a lighter green color than those of higher quality. They may even be a tan color if excessively mature and stemmy.

The presence of **anti-quality factors**, such as tannins, nitrates, alkaloids, cyanoglycosides, estrogens, and mycotoxins, can significantly reduce animal performance even though the hay may appear high-quality. Care should be taken during the growing and harvesting of hay to prevent any accumulation of these anti-quality factors. Weeds can also decrease the quality of hay by diluting out the cell contents and/or fiber components. Animal performance will be reduced because of the presence of unpalatable weed infestation.

Animal Performance

This is the ultimate test of hay quality. **Different levels of animal performance require different hays. Or, different hays produce different animal performance.** For example, lactating ewes require the highest quality hays (maximum palatability, intake, digestibility, nutrient content, and freedom from anti-quality factors) because they need the hay protein, energy, minerals, and vitamins to be transformed into maximum milk production and still be able to maintain their other bodily functions. In contrast, dry, open ewes need less protein, energy, minerals, and vitamins than lactating ewes because all they have to do is maintain their body. They can do this by consuming lesser amounts of lower quality hays that have less protein, energy, minerals, and vitamins. This simple scenario indicates that for maximum performance and efficient production, producers need at least two different quality hays.

Stage of maturity at harvest is the most important factor that affects hay quality. This effect is illustrated through intake and digestibility values shown in Table 1. These data were accumulated over a period of years, were analyzed by researchers (J.B. Stone, G.W. Trimberger, C.R. Henderson, J.T. Reid, K.L. Turk, and J.K. Loosli) at the University of Wisconsin, and were published in the Journal of Dairy Science in 1960. The fact that this research has not been duplicated, but has been used many times over to illustrate the effect of stage of maturity on hay quality, justifies its description as "classic research".

Even though the data in this table were collected from dairy cows, the results can be directly applied to sheep. The data illustrate how the plant growth stages change during the 5-week period from June 3 to July 10 and how the animals responded to these changes when they were offered the hays. Cows consumed over 2.6% of their body weight (BW) daily when they were fed the hay harvested in the vegetative stage. It was clearly highly digestible (63.1%). Consumption level and digestibility, together, indicates this hay was high-quality. If so, it must have been leafy and must have contained a high percentage of nonstructural cell components (cell contents = protein, sugars, and minerals) and a low percentage of cell wall components (structural components = cellulose, hemicellulose, and lignin = fiber). Cows fed the late-bloom hay harvested on July 9/10 ate only 74% as much (1.95% BW) and digested only 82% as much of the hay as those fed hay harvested in the vegetative stage. The relationship between nonstructural (cell contents) and structural (fiber) components in this hay could not support performance near that of the vegetative hay because the cows would not eat it and could not digest a high percentage of what they did eat.

Table 1. Intake and Digestibility of Cool Season Grass Hays by Lactating Dairy Cows[a]

Cutting date	Growth stage	Hay intake/d, % of BW[b]	Hay digestibility, %
June 3/4	Vegetative	2.64	63.1
June 11/12	Early boot	2.36	65.7
June 14, 15	Late boot	2.45	62.6
June 16 - 18	Early head	2.28	58.5
July 1	Bloom	2.30	52.7
July 5	Bloom	2.13	52.2
July 7, 8	Bloom	2.09	52.5
July 9, 10	Late-bloom	1.95	51.5

[a] Summary of several studies using different grasses.
[b] BW = body weight

Table 2. Leaf and Stem Quality of Alfalfa and Timothy Components

Plant component	% of whole plant	CP, %[b]	NDF, %[b]	ADF, %[b]
Alfalfa				
Upper leaf [a]	31	24	28	18
Lower leaf	13	22	26	16
Upper stem [a]	6	13	53	39
Lower leaf	50	9	68	53
Timothy				
Leaf	30	18	49	26
Stem	70	5	73	43

[a] Upper leaf and stem taken from last 5 internodes on each stem.
[b] CP = crude protein; NDF = neutral detergent fiber (synonymous with cell wall constituents); ADF = acid detergent fiber (cell wall constituents minus hemicellulose).

Dr. Mike Collins, formerly of the University of Kentucky Plant and Soil Science Department, published the data in Table 2. This table shows how the leaf-to-stem ratio is a major player in the decline of forage quality as plants mature. Leaves are higher quality (higher protein and lower NDF and ADF) than stems (lower protein and higher NDF and ADF) in both alfalfa and timothy. The proportion of leaves decreases as the proportion of stems increases when the plant advances toward maturity. If the goal is to obtain maximum animal performance from hay feeding, the data in Table 2 show the hay must have maximum leaf content whether it is a legume, like alfalfa, or a grass, like timothy.

Feeding Hay to Ewes

Hay is traditionally fed to sheep (especially ewes) during the winter (November/December to March/April). However, it may be fed during other seasons of the year. For example, ewes that lamb in September/October may be fed a lactation diet of hay and concentrates rather than

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allowing them to graze forage being stockpiled for winter grazing. Or, a late gestation diet of hay and concentrates may be fed prior to lambing in April, although ewes and lambs may graze spring forage later. So, the production phase (Table 3), rather than the season of the year, may be the main factor that determines when hay is fed. **Then, the type and quality of hay to feed depends on the job the ewe has to do**.

Table 4 shows the pounds of dry matter required per day for ewes of different weights to produce efficiently during each production phase. Within a weight class (Example: 150 lb), dry matter requirements are lowest at M (2.6 lb/hd/d), increase 1.5 times during F/B (4.0 lb), drop during EG (3.1 lb), increase again in LG (4.2 lb), and are highest during L (6.2 lb). Once the dry matter requirements are determined, the next step is to decide which hay fed alone or which hay/concentrate combination, and amount of each, will meet these requirements most efficiently.

Remembering the factors affecting hay quality and using the daily feed requirements for different production phases (Table 4), one can quickly surmise that ewes at M and during EG can be fed the poorest quality hay (daily gains of 0.02 and 0.07 lb/hd). If hay has to be fed when ewes are open and dry (M),

Table 3. Production Phases in an Annual Management Program for Ewes

Phase	Length, days
Flushing	14
Breeding[a]	54
Early gestation[a]	110
Late gestation	28
Lactation	60
Maintenance (open, dry)	129

[a] Breeding and early gestation overlap so total days will be greater than 365.

Table 4. Daily Dry Matter Requirements of Ewes[a]

	Production phase[c]				
Ewe weight, lb[b]	M	F/B	EG	LG	L
110	2.2	3.5	2.6	3.7	5.3
130	2.4	3.7	2.9	4.0	5.7
150	2.6	4.0	3.1	4.2	6.2
175	2.9	4.2	3.3	4.4	6.6
200	3.1	4.4	3.5	4.6	7.0
Daily gain, lb	0.02	0.22	0.07	0.50	-0.13

[a]To convert these dry matter values to "as-fed", divide by 0.90 (average).
[b]All weights are based on ewe weights when they are dry, open, and in moderate condition

M = maintenance; F/B = flushing/breeding (2 weeks before and 3 weeks into the breeding season); EG = early gestation; LG = late gestation with 1.80 to 2.25 lambing rate expected; L = lactation (first 8 weeks nursing twins).

feed the daily amounts of the lowest quality (late-bloom or mature grass) as shown below. Feeding larger amounts will be wasteful.

If hay has to be fed during F/B, it should be medium-quality (early-boot for grass or mid-bloom for legume) to produce a daily gain of 0.22 lb/hd (Table 4). Feeding hay alone will not produce this gain because the fiber contained within is more undigestible than is the starch/sugar provided through concentrates (grains). Therefore, extra dietary energy is needed to produce the needed gain. Usually, this will be provided by shelled corn or a corn-based mixture. The following amounts of hay and corn should be fed to ewes of different weights during F/B.

Ewe weight, lb	Hay/hd/d, lb
110	2.75
130	3.00
150	3.25
175	3.50
200	3.75

More hay than the amount required for ewes to do their job can always be fed.

Ewe weight, lb	Medium-quality hay,lb/hd/d	Corn, lb/hd/d
110	3.0	.60
130	3.1	.70
150	3.3	.80
175	3.4	.90
200	3.5	1.00

However, feeding excess is wasteful from the standpoint that ewes may use it for bedding or they may get too fat. Because hay is the most expensive feedstuff consumed by ewes, on an annual basis, correct amounts should be fed during each production phase if economic efficiency is a production goal. **Also, any hay (grass or legume) of any quality (Table 1) can be fed in any production stage (Table 3). But, amounts fed must be flexible and depend on type of hay, its quality, and the production stage of the sheep that will consume it.**

Ewes gain 0.07 lb/hd/d during EG (Table 4). This is only 0.05 lb/hd/d more than for M ewes. EG ewes can be expected to gain this amount if the low-quality hay fed during M is replaced with medium-quality grass (early-head to bloom: Table 1) or late-bloom legume. If the same hay, fed during M, has to be fed during EG, supplementing with 0.25 lb/hd/d (110-lb ewes) to 0.50 lb/hd/d (200-lb ewes) shelled corn will be necessary to produce 0.07 lb/hd/d gain.

Nutrient requirements increase dramatically during LG and become even higher during L (Table 4). The second highest quality hay (boot for legumes to early-head for grass and mid-to late-bloom) should be fed during LG with the highest quality (vegetative to boot stage for grass and early-bloom to mid-bloom for legume) reserved for L. Even medium-quality hay fed in LG and high-quality fed during L will require energy supplementation (usually shelled corn or a corn-based mixture) to stimulate the needed body weight gain in LG (0.50 lb/hd/d) and to prevent ewes from losing more than 0.13 lb/hd/d during L (Table 4). Some suggested daily rations for ewes of different weights in LG and L are shown in Tables 5 and 6, respectively. The hays described in these tables can be grass, grass/legume, or legume. **Legume hays are preferred for LG and L**. In the event low-quality hays (headed out for grass or full-bloom for legume) have to be fed during these production stages, supplementation with soybean meal (0.25 in LG and 0.5 lb/hd/d in L) will be required to meet protein requirements. Do not feed any more low-quality hay or corn. Simply feed the soybean meal in addition to the amounts of hay and corn shown in Tables 5 and 6. **Still, for best performance, feed the second highest quality hay in LG and the highest quality in L**.

Provide ewes ad libitum access to loose, complete mineral, manufactured specifically for sheep, every day of the year.

Table 5. Daily LG Rations (lb/hd/d) for Ewes of Different Weights and Expecting a 1.8 to 2.25 Lambing Rate

	Ewe weight, lb [a]				
	110	130	150	175	200
Ration ingredient					
Medium-quality hay [b]	3.5	3.7	4.0	4.0	4.2
Shelled corn	0.5	0.7	0.8	1.0	1.0

[a] All weights taken when ewes are dry, open, and in moderate condition.
[b] Boot to early head stage for grass; mid- to late-bloom for legume.

Table 6. Daily L Rations (lb/hd/d) for Ewes of Different Weights and Suckling Twins (First 8 Weeks Lactation)

	Ewe weight, lb [a]				
	110	130	150	175	200
Ration ingredient					
High-quality hay [b]	4.5	4.7	5.0	5.5	6.0
Shelled corn	1.5	1.8	2.0	2.0	2.2

[a] All weights taken when ewes are dry, open, and in moderate condition.
[b] Vegetative to early boot stage for grass; early bloom for legume.

Summary

If we don't know the quality of hay we plan to feed to our sheep, all we have to do is feed it and see if they eat it. If they readily consume it, the hay is palatable, digestible, will have a high percentage of plant cell contents in relation to structural (fiber) components, and will be free from anti-quality factors. The resultant hay will be green, leafy, soft to the touch, and will smell and taste sweet.

Although hay is traditionally fed to sheep during winter, it can be fed during any production phase of the calendar year. Hay is also the most expensive feedstuff we feed. Therefore, the quality of hay to feed depends on the job the sheep are expected to do. In other words, there is "a hay for every season". Feed ewes the lowest quality during maintenance and the second lowest quality during early gestation. Feed higher quality during flushing and breeding. The second highest quality hay needs to be fed in late gestation. Save the highest quality and quantity for lactation.

Hay can be fed to any sheep during any season of the year. Its successful use, however, depends on how efficiently the qualities and quantities are coordinated with the production phases the sheep progress through during the year.

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