

Managing Feed Quality Issues to Maximize Health and Productivity

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Abstract

Veterinarians are becoming increasingly involved in nutritional management on their clients' dairies, and are more frequently being consulted about feed quality and feed delivery issues. Many fresh cow problems that veterinarians treat are nutritionally related and cannot be resolved without making changes in nutritional management around the time of parturition. Maximizing feed quality, regardless of whether the feedstuff is harvested on-farm or is purchased, is extremely important in maximizing profitability and minimizing disease on the dairy farm. Maintaining feed quality during storage and feedout is equally important. Dairy feeds can be classified into five general categories: 1) fermented forages, 2) dry forages, 3) commodities, 4) additives and 5) vitamin-mineral packages. Even though feed quality management is generally focused on forages, other categories of feedstuffs should also be addressed. Veterinarians need to be well-informed on feed quality issues, regardless of whether or not they are doing actual ration formulation on the farm.

Résumé

Les vétérinaires sont de plus en plus impliqués dans la régie de l'alimentation des fermes laitières de leurs clients et sont consultés plus souvent à propos de la qualité des aliments et de leur mode d'approvisionnement. Plusieurs des problèmes que l'on retrouve chez les taures vèlées récemment, et qui sont traités par les vétérinaires, sont associés à l'alimentation et ne peuvent pas être résolus sans faire de changements dans la régie de l'alimentation au moment de la parturition. La maximisation de la qualité des aliments, peu importe si les aliments sont produits à la ferme ou achetés ailleurs, est très importante afin de maximiser les profits et de minimiser l'impact des maladies dans une ferme laitière. Le maintien de la qualité des aliments durant l'entreposage et l'utilisation est tout aussi important. Les aliments dans les fermes laitières peuvent être classifiés dans cinq grandes catégories: 1) les fourrages fermentés, 2) les fourrages secs, 3) les denrées, 4) les suppléments et 5) les mélanges à base de vitamines et de minéraux. Bien que la régie de la qualité des aliments se rapporte surtout au fourrage, on devrait aussi mettre l'accent sur les autres types d'aliments. Les vétérinaires devraient

être bien informés au sujet des enjeux de la qualité de l'alimentation peu importe leur degré de participation à la formulation de la ration à la ferme.

Forage Inventory Management

Maintaining the consistency of the ration as well as the ingredients in the ration is important when trying to maximize feed efficiency and milk production. The rumen microflora consist of numerous different strains of bacteria and protozoa that are easily inhibited or destroyed by changes in rumen pH. When a feed change is made that involves switching to a different feedstuff, there will be a shift in certain populations of rumen microflora in order to adjust to the new feedstuff. This adjustment is not rapid and may take up to several weeks to complete. Running out of forages at the end of the year, especially fermented forages, can create tremendous problems with digestive upsets and milk production levels. Dairymen usually try to locate another forage source that can be used temporarily until the new crop can be harvested or purchased. The quality of these forages is usually very poor and the forages are often the leftovers from other farms that were considered too poor to feed to their own animals.

Dairymen need to carefully calculate their forage needs for the year, including their young stock, and have at least a 25% surplus on hand, especially fermented forages. There will always be a certain amount of dry matter loss that occurs during the fermentation process. The goal is to keep this loss at a minimum of around 10-15%. Unfortunately, these dry matter losses or "shrinkage" will commonly run up to 25-30% depending on the moisture content, stage of maturity, method of storage and packing density. Excessive shrinkage decreases available inventories and often leads to emergency purchases at the end of the crop cycle.

Having only one bunker or upright silo causes serious problems with inventory management. Farmers try to use silage at a rate where it will run out when the new crop is ready. This may cause too slow of a feedout rate resulting in more dry matter losses. Sometimes, old silage is either covered up with new crop or is moved out of the silo and repacked on the ground, causing significant loss in dry matter and quality. If two silos are available, one can be finished out as the other is being filled at the time of harvest.

It is also often difficult to locate dry forages at the end of the crop cycle. Dairymen are often forced to purchase low quality, rained-on hay if they have miscalculated their hay needs for the year. This poor quality hay becomes remarkably more valuable than it was during harvest time, thus increasing feed costs with poorer-quality feeds. Very few dairymen will ever complain if they have an excess of high-quality feed at the end of the year.

Fermented Forages

The stage of maturity and the moisture level of forage being harvested are extremely important. Allowing a forage to become overly mature will increase the fiber level and decrease the total digestible nutrients available to the animal. Most researchers recommend that corn should be harvested for silage when the kernel is between the 1/3 and 2/3 milkline stage. Ensiling corn that is either too high or too low in moisture can increase dry matter losses (DML). Studies have shown that normal DML at 60 to 70% moisture averages about 15.3%. If more than 70% moisture, the DML averaged 21.4%; and if less than 60% moisture, the DML averages 26.5%. The ideal moisture level for corn silage is 65-70%.

Studies have been conducted to determine the effect of using a kernel processor on the digestibility of corn silage and subsequent milk production. A kernel processor allows the corn silage to be chopped at a longer length without having long pieces of cob left over in the feed bunk. The kernel processor crushes the cob as well as the kernels of corn, and also crimps the stover, thus allowing a better pack even though the fiber length is longer. This allows the cow to digest a larger percentage of the stover, cob and kernel, and still provide for better rumen health because of longer fiber length. Kernel processors make it possible for corn to be harvested at a more mature stage, yielding more grain, and at the same time improving starch and fiber digestibility. If allowing corn to mature more (high percentage of the kernel in the black line stage), it is advisable to use one of the newer hybrids that has been bred for improved stover digestibility.

Alfalfa silage should be harvested at 60 to 65% moisture. It is very common to see alfalfa silage ensiled at more than 70% moisture. This increases dry matter losses as well as the level of soluble protein. High levels of soluble protein in the ration can increase milk urea nitrogen and blood urea nitrogen levels, resulting in decreased reproductive efficiency. Excessive ammonia in the rumen also requires a significant amount of energy to process the ammonia into urea for excretion from the body. This decreases the amount of energy available for milk production as well as weight gain and reproduction.

The length of the chop on both corn silage and alfalfa silage are important for providing adequate effective fiber to the rumen. Pennsylvania State University has developed an apparatus called the Penn State Forage Particle Separator. This apparatus consists of four compartments on top of each other. The top sieve has holes in it with a diameter of 0.75 inches, the next sieve is 0.31 inches and the third sieve is 0.05 inches. Following are the recommendations published by Penn State for particle size, as measured by their Forage Particle Separator:

	Corn Silage	Haylage	TMR
Upper Sieve (0.75")	3-8%	10-20%	2-8%
Middle Sieve (0.31")	45-65%	45-75%	30-50%
Lower Sieve (0.05")	30-40%	20-30%	30-50%
Bottom Pan	<5%	<5%	<20%

The Particle Separator is very affordable and can be used on the farm to set the proper chop length on ensiled forages. It is also helpful to utilize the separator to analyze the particle length of the total mixed ration (TMR). Too short of particle size in the TMR can result in diarrhea and depressed fat test. Since the passage rate through the animal is increased, the dairyman may notice an increase in dry matter intake without a resulting increase in milk production. Harvesting forages at optimum maturity, moisture level and chop length will greatly improve the feed quality and the income received over feed cost.

Silage preservatives or inoculants are also a valuable tool to improve quality of ensiled forages. Following are four important points of a good silage inoculant:

1. Dominates the fermentation process by rapidly growing lactic acid bacteria, resulting in a rapid drop in pH.
2. Contains propionic acid-producing bacteria to inhibit yeast and mold growth and improve aerobic stability.
3. Includes an enzyme package designed to specifically soften the kernels and open the fiber in the stover to improve digestibility.
4. Includes a stimulant to activate the bacteria rapidly.

Dropping the pH rapidly decreases the heat produced during the fermentation process as well as preventing growth of the undesirable bacteria, such as *Clostridium* species. The amount of soluble protein produced from the fermentation process is also decreased when using a good silage preservative. The overall result is a higher quality silage with improved digestibility, less

dry matter loss and increased milk production. These high quality silages are also more stable at feedout and do not cause as much heat buildup in the TMR in the feedbunk. Inoculants come in either a powder form or liquid. In the past, it has been commonplace to apply the powder form on top of silage in the pit after each load has been dumped and packed, or placing the liquid form on top of a truckload of silage when being weighed on a scale. Now it is possible to use both powder and liquid applicators that are mounted on the chopper and apply the inoculant in a more uniformly. This process is much preferred and improves silage fermentation.

When filling bunker silos, the pit must be filled fast enough to prevent spoilage and slow enough to allow adequate time for packing. The suggested packing rate is 800 to 1,000 hour-pounds per ton of silage. The filling rate in tons per hour equals the weight of the vehicle used for packing divided by 800. For example:

$$\frac{26,000 \text{ lb. tractor}}{800 \text{ hour lb}} = 32 \text{ tons per hour}$$

Without sufficient packing, air becomes entrapped and leads to improper fermentation and spoilage. If too much time is spent packing and the surface is exposed to air during this time, spoilage will occur on the surface. This is often seen as a horizontal black line through the face of the silage. The forage can be harvested at optimum maturity, moisture level and chop length and still be of poor quality if it is packed too fast or too slow.

Many large dairies commonly pack the silage on flat ground instead of in silos. Initially, the silage was packed in the same manner as a bunker silo in a progressive wedge method on a 30-40% grade. However, without walls to pack the silage tightly against, this method results in tremendous dry matter losses along the back and sides of the silage pile. A newer method called the "drive-over" pile allows for the packing tractor to drive over the pile both from end to end as well as from side to side. This allows the appropriate amount of packing weight to be distributed on the entire surface of the silage pile. It is common to see dry matter losses of 25 to 40% using the progressive wedge method on silage piles. The drive-over piles can be managed to control dry matter losses to around 15%.

Covering the bunker silo as fast as possible with plastic will greatly decrease spoilage and dry matter losses. A 1993 study by Rotz showed the use of a plastic cover on bunker silos can return up to \$8.00 for each dollar spent on plastic and labor by reducing supplemental feed, and improving milk production. Tires placed on the plastic cover should be touching each other. The cover should be inspected on a routine basis and any

holes patched to prevent air from entering and increasing chances of mold formation.

A significant loss in feed value can also occur at the time of feedout. Bags and bunker silos should have at least five inches removed off the entire face every day. If less is removed, the face is exposed to air and yeasts and molds grow rapidly, resulting in more dry matter loss and decreased palatability. When designing a bunker silo or determining the size of bags for the amount of silage being fed, the following formula can tell you the width needed in order to remove the proper amount of silage per day:

$$\text{Width (feet)} = \frac{12 \times \text{amount fed in lb dry matter per day}}{\text{silos height (ft)} \times \text{silage density} \times 5}$$

The average density of hay silage is 14.8 lb of dry matter per cubic foot.

The average density of corn silage is 17.7 lb of dry matter per cubic foot.

For example, if feeding 6,000 pounds of corn silage per day (dry matter basis):

$$\text{Pit width} = \frac{12 \times 6,000 \text{ lb per day fed}}{12 \text{ feet high} \times 17.7 \text{ lb/cu ft} \times 5 \text{ inch removal}} = 67.8 \text{ feet}$$

For 5 inch removal per day the pit width would need to be 67.8 ft maximum.

For 12 inch removal per day it would be 28.25 ft maximum.

It is common to see pits so wide that silage is only removed from one side of the pit at a time, exposing the other side to air for extended periods of time. Dividing wide pits into two narrower pits can make a significant improvement in the quality of silage as it is being fed out.

Care should be taken to minimize the disruption of the integrity of the face of the silage pit. The tip of the loader bucket should be pointed downward and the face of the pit shaved off from top to bottom. Pushing the bucket into the bottom of the face and lifting upward loosens the entire face and permits air to enter, with subsequent yeast and mold growth and increasing dry matter losses. Silage defacers are available that allow the face to be shaved off while maintaining the integrity of the face and decreasing the amount of air entering the silage at the time of feedout. Any loose silage that has been dislodged should be cleaned up at the end of the day to prevent molding.

Plastic covers on bunker silos and above-ground piles should only be pulled back enough to allow for two

to three days of feedout. The top surface of obviously spoiled silage should be pitched off and not be fed. This layer has very little nutrient value and usually contains high numbers of yeast and mold spores, as well as mycotoxins. If feeding out of a progressive wedge pile, there will often be large areas of mold on the shoulders of the pile. Any areas with obvious mold should be discarded and not fed.

All silages should have a fermentation analysis done on them to determine the quality and palatability. Silages with high levels of acetic and/or butyric acid were more likely put up too wet. These silages are less palatable and may have a significant effect on the dry matter intake of the TMR. These types of silages should comprise a smaller portion of the TMR in order to minimize the negative effects on palatability and dry matter intake.

Some dairies must move silage from the storage area to the feeding area or have purchased silage from another farmer and transported it to their own dairy. Depending on the amounts used and the size of the truck hauling the silage, there may be several days of silage sitting in the feeding area. This causes a severe problem with heating and dry matter losses due to yeast and mold growth. There are several products that can be applied to the silage when it is moved to prevent or control the yeast and mold growth. Propionic acid is commonly used, and a newer product recently available is a potassium sorbate solution. Both products work well, but the potassium sorbate is more palatable and does not corrode equipment like the propionic acid. These products will usually control the yeast and mold growth for five to seven days during feedout.

Dry Forages

Alfalfa is probably the most widely used forage in dairy cattle diets. It matures rapidly, especially in hot, dry weather. If alfalfa hay is the only forage in the diet, it must provide a certain amount of fiber in order to optimize rumen health. If cut as dry hay in a very early stage of maturity, (neutral detergent fiber less than 40%), it may be difficult to provide enough fiber in the ration. However, the less-mature plant will have a higher percentage of protein, energy, and total digestible nutrients, which decreases the amount of costly concentrates that need to be added to the ration for proper balancing. Can alfalfa hay be harvested too early? If it is the only forage in the ration, and no grass or small grain hay is available, then it would be possible to cut it too early. This would not allow for adequate levels of fiber in the ration and could result in depressed butterfat, acidosis, diarrhea and increased passage rates through the cow, resulting in increased dry matter intakes without an increase in milk production. In this case, the ideal level

of neutral detergent fiber (NDF) in the alfalfa would be about 40% of the dry matter. However, if the farmer waits until the NDF is 40% before starting to cut the hay, a large percentage of it will be close to 50% before he is finished. It is suggested that the harvesting process should begin when the hay is approximately 30 to 35% NDF. The size of the field will also have an effect on when harvest should begin. Larger fields that take longer to cut may need to be started at an earlier stage of maturity than smaller fields.

Cutting the first crop of alfalfa hay earlier has several advantages. In colder areas of the United States, three crops of alfalfa hay are all that the climate will allow, and sometimes the third crop does not grow enough to harvest. Cutting the first crop early will increase the chances of being able to harvest a good third crop. Also, in some areas, the alfalfa weevil isn't quite mature when the first crop is cut early, and many of them are removed from the field before reproducing.

I personally do not feel that alfalfa hay can be cut too early as long as another, higher-level fiber source can be added to the ration. I would much rather feed high-quality alfalfa hay with a relative feed value of 200 and add a few pounds of grass or oat hay than to feed straight alfalfa hay with an NDF greater than 45. High-quality hay usually decreases the cost of the ration by providing higher levels of more digestible protein and energy, thus decreasing the amount of added grain and protein concentrates. Alfalfa hay is not usually considered a good energy source, but I have often seen high-quality alfalfa hay with a net energy for lactation (NEL) higher than corn silage. This makes it much easier to formulate a ration with adequate fiber and energy levels without having to add as much grain. Following is an analysis of a high-quality alfalfa hay and corn silage from the same dairy:

	Alfalfa Hay	Corn Silage
Crude protein	25.10%	7.50%
Net energy lactation	0.77 Mcal/lb	0.71 Mcal/lb
Acid detergent fiber	22.40	28.30
Neutral detergent fiber	29.30	46.90
Relative feed value	227	

It is obvious from these results that high-quality alfalfa hay can be a valuable source of energy in the ration, and may decrease feed costs.

Dry alfalfa hay should be harvested at 15 to 18% moisture. This allows enough moisture to prevent excessive loss of leaf and dry enough to prevent molding in the bale. Some farmers spray propionic acid on hay as it is baled in order to bale the hay at a high moisture level; the propionic acid inhibits yeast and mold growth.

Potassium sorbate has recently come onto the market and appears to have several advantages over propionic acid. It is not as corrosive to metal equipment and is more palatable to the cow.

If purchasing forages, it is advisable to price the forage being purchased according to its quality. Many dairymen utilize the Relative Feed Value (RFV) of alfalfa to determine purchase price. RFV is a calculated figure that utilizes the acid detergent fiber (ADF) and neutral detergent fiber (NDF) values of the alfalfa. ADF is utilized to calculate the digestible dry matter (DDM) and NDF is utilized to calculate the dry matter intake (DMI), both of which are used in the formula to calculate RFV.

$$RFV = \frac{DDM \times DMI}{1.29}$$

$$DDM (\%) = 88.9 - 0.779 \times ADF (\% \text{ of dry matter})$$

$$DMI (\% \text{ of body wt}) = \frac{120}{\text{Forage NDF } (\% \text{ of dry matter})}$$

An RFV of 150 is usually used for the average market value of alfalfa hay for that region. For every point above 150, the hay producer receives 50 cents to \$1.00 more. For every point below 150, the same amount is subtracted. If hay is normally \$150.00 per ton at an RFV of 150, it would be worth up to \$175.00 per ton if the RFV was 175. Although this seems like a high price for high quality hay, both the producer and dairyman come out ahead.

Kansas State University has developed a spreadsheet that considers the current price of corn and soybean meal when it calculates the value of the alfalfa hay based on its RFV. If the current price of corn and soybean meal is high, then the value of the alfalfa hay is higher since it provides a certain amount of the protein and energy in the ration. Following is a chart utilizing the spreadsheet to calculate the value of alfalfa hay with a price for corn at \$6.15 per cwt and soybean meal at \$15.00 per cwt:

ADF	NDF	RFV	Forage Value/Ton
38	48	115	\$125.14
31	42	143	141.22
20	30	227	161.21

Although these prices are obviously outdated, it still illustrates the point that alfalfa with a higher RFV is worth much more from a nutrient standpoint.

Milk production often increases several pounds when switching from one hay to another with very similar RFVs. The main reason for this is that the fiber in the hay that improved milk production was more digestible than that of the previous hay that was fed. This is called NDF digestibility (NDFD), and testing for this is rapidly gaining popularity in the feed industry. Even though RFV gives some indication of the quality of the feed as far as the fiber content was concerned, it did not give any information as to how well the forage would be utilized in the rumen. As a result, a new formula was developed by researchers at the University of Wisconsin (Dr Daniel Undersander) and the University of Florida (Dr. John Moore) that considers the fiber digestibility of the forage and subsequently gives the dairyman a better idea of the overall quality of forage being fed. This new index of feed quality is called Relative Forage Quality (RFQ).

In the formula for determination of RFQ, digestible dry matter (DDM) is replaced by total digestible nutrients (TDN). Both TDN and the dry matter intake (DMI) now utilize fiber digestibility in their calculation. Since DDM is no longer utilized in the calculation, ADF is no longer utilized in the determination of RFQ. Following are the current formulas used for the calculation of RFQ:

For RFQ:

$$RFQ = (DMI, \% \text{ of body weight}) \times (TDN, \% \text{ of dry matter}) / 1.23$$

The value 1.23 ensures the equation has a mean and range similar to that of RFV.

For TDN:

$$TDN = (NFC \times .98) + (CP \times .93) + (FA \times .97 \times 2.25) + (NDFn \times (NDFD/100)) - 7$$

Where:
 CP = crude protein (% of dry matter)
 EE = ether extract (% of dry matter)
 FA = fatty acids (% of dry matter) = ether extract - 1
 NDF = neutral detergent fiber (% of dry matter)
 NDFCP = neutral detergent fiber crude protein
 NDFn = nitrogen free NDF = NDF - NDFCP, else estimated as NDFn = NDF * .93
 NDFD = 48-hour *in vitro* NDF digestibility (% of NDF)
 NFC = non-fibrous carbohydrate (% of dry matter) = 100 - (NDFn + CP + EE + ash)

For DMI (dry matter intake):

$$DMI = 120 / NDF + (NDFD - 45) \times .374 / 1350 \times 100$$

Where:
 DMI is expressed as % of body weight (BW)

NDF as % of Dry Matter (DM)

NDFD as % of NDF

45 = average value for fiber digestibility of alfalfa and alfalfa/grass mixtures

To use this new formula for determining the RFQ of a given forage, it is necessary to analyze the forage for its 48 hour NDF digestibility. This is done by grinding a sample, determining the amount of NDF in it and then incubating it for 48 hours in rumen fluid in the lab. The amount of NDF left after the digestion is measured, and then subtracted from the original NDF determination to get the amount of NDF that was digestible. The procedure for testing the NDF digestibility of forages in the laboratory is relatively new and fairly complicated. It is only offered at a few of the more progressive forage testing laboratories in the country. Following are the names and addresses of a few of the laboratories currently running NDF digestibilities:

Cumberland Valley Analytical Services
P.O. Box 669
Maugansville, MD 21767

Cumberland Valley Analytical Services
14515 Industry Drive
Hagerstown, MD 21742
Phone: 800-282-7522
Fax: 301-790-1981

Rumen Fermentation Profiling Lab
Attn: TK Miller Webster
P.O. Box 6108
1045 Ag Sciences Bldg.
Division of Animal and Vet Sciences
West Virginia University
Morgantown, West Virginia 26506-6108
Phone: 304-293-2631 ext. 4443

F.A.R.M.E. Institute
P.O. Box 88
5385 Rt. 41
Homer, NY 13077
Phone: 607-749-5747

Dairy One
730 Warren Road
Ithaca, NY 14850
Phone: 800-496-3344

The Relative Forage Quality index now allows us to truly compare two different forages for the feeding value to the cow. It is important to remember that just because two forages have the same RFV, does not mean that you will receive the same amount of milk from both

forages. The forages with the highest RFQ value should be saved for the lactating cows. The RFQ value allows us to more accurately compare alfalfa silage to alfalfa hay. This would be most helpful when purchasing forages, and determining which home-grown forages should be fed to your lactating cows.

Some of the more recent computer programs used to formulate dairy rations actually utilize NDF digestibility in the calculations. These rates of digestion must be calculated and may require that the NDF digestibility analysis from the lab be run for a shorter period of time, such as 30 hours. One such program is the CPM ration formulation program. CPM stands for Cornell University, University of Pennsylvania and Minor Research Institute. These three well known research facilities have worked together in the writing and development of this program, which utilizes the most recent information available in the calculations used for formulating rations.

The RFQ index is designed mainly to determine the quality of legumes and grasses. The RFV index has always underestimated the quality of grasses, since they usually contain a higher level of NDF than legumes. However, even though the NDF is higher in grasses than legumes, the digestibility of the NDF in grasses is higher. However, the rate of digestion of the NDF in grasses is slower than that of legumes, which is a problem. This causes grass forages to stay in the rumen for longer periods of time, which in turn, slows the passage rate through the rumen. A slower passage rate results in decreased dry matter intakes, which in turn decreases milk production. With the new RFQ index, grasses are given credit for their increased NDF digestibility and will have a higher RFQ value than their previous RFV value.

Even though the RFQ index will mainly be used for legumes and grasses, NDF digestibility can still be an extremely valuable number to aid in determination of the quality of corn silage. The same principles exist with corn silage as far as the increase in milk production observed when the NDF digestibility is greater. Therefore, the NDF digestibility can be used similarly to the RFQ index when determining the quality of the corn silage when purchasing or formulating rations. Many of the seed companies are developing strains based on their NDF digestibility. Some of these "silage specific" strains have a significantly higher NDF digestibility and result in higher milk production. However, yield per acre of these silage-specific strains of corn are often lower than other strains. Instead of looking only at yield per acre, some companies are now looking at milk yield per acre. These silage-specific strains often yield more milk per acre than other strains containing more lignin and less digestible NDF.

Dr. Michael Hutjens, a dairy nutritionist at the University of Illinois, has developed a new formula called the Total Forage Index that also considers the protein

level of the forage. His formula utilizes a protein multiplier depending on the cost of supplemental protein and whether or not crude protein is deficient in the ration. It is an excellent way to determine the value of alfalfa hay in the ration and what a fair purchase price would be.

Regardless of whether the alfalfa hay is harvested on-farm or purchased, the bales should be tested with a moisture meter before being stacked in the storage area. If the hay is more than 16-18% moisture, there is a chance of heating, causing caramelization of the proteins and spontaneous combustion. Many large dairy farms have a catwalk along side the scales and check the moisture level in the bales while the truck is being weighed. Any bale that is too high in moisture is marked with spray paint, and is set aside when unloaded. The seller has the option to haul the hay off or not charge for it and leave it at the farm. Any bales that are noticeably full of weeds are also set aside. When feeding hay, any bales with noticeable mold should also be discarded.

Storing hay in a hay barn helps preserve the quality significantly. Moisture is the biggest enemy to quality once hay is harvested. Second best is covering the hay with water-proof tarps, but getting these to successfully stay on is difficult. Hay has become such a valuable feedstuff that the dairyman pays for the hay barn whether he has one or not because of the loss in feed quality.

When running a forage analysis on alfalfa hay, it is preferable to use a wet chemistry method from a reputable lab. It is important to request the chloride level in addition to other minerals since it is valuable in calculating the dietary cation-anion difference (DCAD) in the TMR. The DCAD is important in both the lactating (positive DCAD) and the close-up dry cow ration (negative DCAD). Finding a source of low-potassium hay is very beneficial for formulating rations for close-up dry cows that need a negative DCAD to improve calcium absorption around the time of calving. High iron and ash content of alfalfa hay is usually indicative of a significant amount of dirt in the hay. This could be due to high water flow rates with flood irrigation or high winds blowing dirt around the time of harvest. In some areas, especially where drought conditions exist, the hay should be tested for nitrate content as well. This is especially true for oat hay.

When all hay has been harvested and/or purchased for the year, it is important to manage inventories so that some of the highest-quality hay is set aside for the younger heifers. The higher protein and digestibility of high-quality hay is necessary for these heifers to reach their growth potential.

Commodities

Most dairy rations contain corn in some form as a source of starch and energy. Regardless of the form

when fed, corn can vary significantly in quality and digestibility. High-moisture corn is generally accepted as the most rapidly digestible form, with steam-flaked corn close behind it. The variation in quality of steam-flaked corn is tremendous and depends on the cooking times, temperatures and flaking process. Running starch gelatinization and available glucose tests allows one to compare flaked corn from different sources and determine which one is the best value. If the steam-flaked corn is too moist, a problem with molding can occur. Large dairies that purchase truckloads of corn should have two commodity bays set aside for this product. If not, the corn that remains in the back of the one bay, and is continually covered over with new grain, will become moldy. It is advisable to check corn for mycotoxins on an occasional basis. If the cows are exhibiting signs of mycotoxicosis, the fermented feeds, corn, corn distillers, cotton seed and almond hulls would be the most likely suspects and should be tested.

Good quality steam-flaked corn is rarely found in the manure. If particles are observed in the manure, then the quality should be questioned. Many dairymen think that they get similar results from ground corn and steam-flaked corn. Even when the corn is ground extremely fine, there will still be some larger particles visible in the product, and these particles will also be observed in the manure. If there is a concern about acidosis in fresh cows, some nutritionists will switch to a ground corn since it is digested somewhat slower than steam-flaked corn.

If looking at other starch sources such as barley, the bushel weight of the product is a good sign of quality. Lighter weight grain will contain more hull and less meat, and will test significantly lower in starch. Barley is currently over-priced as an energy source in most dairy rations and is not used as much as in the past.

Protein sources for dairy rations have tremendous variability in quality and amino acid balance. Corn distillers is currently available in large quantities in much of the US because of ethanol plants. However, this is one of the least-consistent products on the market. It will vary from one load to another from the same source in protein content, protein availability and fat content. It is very low in lysine, which is one of the limiting essential amino acids in the diet, and contains relatively high amounts of C18:1T, which is a fatty acid that is inhibitory to rumen fermentation as well as suppressive to butterfat content in milk. This product has also been found to contain higher levels of mycotoxins than the original corn it was derived from.

The quantity of available protein, amino acid balance, protein degradability and fat content should all be considered when purchasing proteins. Balancing rations for amino acid content is a well-accepted practice and has been proven to improve milk protein content and

overall milk production. Amino acid balance is especially important when purchasing rumen-undegradable proteins (bypass protein).

The Ohio State University has developed an excellent program called "Sesame" that estimates the "break-even" prices of up to 140 types of feedstuffs based on their nutrient content, such as metabolizable energy, rumen degradable protein and neutral detergent fiber, according to current market prices. Commodities and forages can be evaluated together, and their value in the ration compared. In general, this program illustrates that high-quality forages are often undervalued, even in the current market. Utilizing large amounts of high-quality forages is the most economical way to feed animals efficiently, while providing the required nutrients at the lowest cost. This program can be downloaded from the following site: <http://www.sesamesoft.com>.

Minerals

Unfortunately, the exact content of mineral mixes is often unknown and is the main source of income for a high percentage of feed companies. Substitutions are frequently made without the knowledge of the nutritionist or veterinarian. When mineral mixes are analyzed for calcium, as an example, it cannot be determined what the calcium source is. The same is true for trace minerals, which are extremely expensive. A good example would be a chelated copper versus copper sulfate, the latter being much less expensive and much

less available to the animal. As a general rule of thumb, if a specific mineral mix is sent out for a bid to more than one company and the bids come back significantly different, the lower bid often contains products that are less expensive and have been substituted for the higher-quality minerals.

Conclusion

Veterinarians have been excluded from the field of nutrition for many years and only recently are becoming more involved in the decision making processes that play such an important role in the nutritional well-being of the dairy animal. Understanding the many ways that feed quality influences the overall productivity and profitability of dairy operation is essential if the veterinarian wants to play a significant role on the management team in the field of nutrition. The veterinarian can provide important information and advice concerning nutrition even though not directly involved in formulating rations. Dairy management meetings with the nutritionist and the veterinarian in attendance can result in the implementation of an excellent nutrition and herd-health program where both consultants can work together for the benefit of their dairy clients. Many veterinarians are developing expertise in the field of nutrition and are currently formulating rations for their dairy clients. This is a potential area of additional income that can be developed in many practices.