Reading a Forage Analysis Report

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Forage quality has a direct impact on feed cost and milk production of a dairy operation. As the quality of forages decreases, the amount of concentrate that needs to be fed increases. Studies also have shown that additional grain cannot always overcome decreases in forage quality, resulting in lower milk production. Both of these factors negatively impact income over feed cost and are often observed when lower quality forages are fed. To determine the quality of forages available to be fed or purchased, they must be tested for their nutrient content by a forage testing laboratory. These results provide the nutritionist with the concentration of each nutrient the forages can supply and are used to balanced rations to be fed to the milking dairy herd, dairy heifers, and/or dry cows. In addition, these results should be used to allocate forages to different groups of cows and/or heifers based on their needs. This process allows one to best utilize available forages in a dairy operation.

Collecting Representative Samples

To effectively utilize harvested or purchased forages in balanced rations, representative samples need to be collected after harvest.

For bales of dry hay or baleage, 10 to 20 core samples from each lot should be collected using a hay probe (example probe shown in picture). A lot of hay or baleage is defined as that harvested from one field and harvested and stored under uniform conditions. These core samples then are placed in a pail and hand mixed, a subsample is collected, the subsample is placed in a plastic quart bag, and sent to the forage laboratory to be analyzed using either wet chemistry or NIR methods.

For silage, stored in an upright, samples need to be collected after the unloader has run for a short time where fresh silage is being unloaded. For silages stored in bags, a hay probe (the hole is then sealed with tape) can be used to sample forages before they are fed. For piles or bunker silos, the recommendation for sampling has changed for human safety reasons. People can be severely injured or killed from collapsing silage. Silage should be collected across the entire face of the silo using a defacer or bucket of the feeding tractor. This silage is added as the sole ingredient and mixed within a TMR wagon for 3 to 5 minutes, dumped back on the concrete/asphalt pad, and a sample taken about halfway through as the mixer wagon is being

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unloaded. This procedure prevents silage from falling and injuring those collecting the sample. Forage samples are placed in sealed plastic quart-size bag, sent to the forage laboratory, and can be analyzed using either wet chemistry or NIR methods.

Evaluation of Forage Analysis Reports

Forage analysis reports are used to

- Evaluate a forage program and
- Balance rations for lactating dairy cows, heifers, and dry cows.

Many different nutrients are provided on these forage reports. All of these numbers are important when balancing rations for dairy cattle. However, 2 or 3 nutrients or analyzed components should be evaluated first before others. These include dry matter content and acid detergent fiber (ADF) and/or neutral detergent fiber (NDF). These fiber values reflect the energy content of the forages, which is the nutrient needed in the largest quantity, is the most expensive, and often is the hardest nutrient to provide to dairy cows.

- **Dry matter content:** The dry matter content of stored forages reflects the amount of moisture at harvest and after storage. (For all feeds, when added together the moisture and dry matter percentage equals 100 %.) Dry hay generally contains 88 to 92% dry matter (8 to 12% moisture). Dry hay stored outside generally is lower in dry matter content. Round bale silage or baleage generally contains 40 to 60% dry matter. With silages, the type of storage structure reflects the optimum dry matter content at harvest and storage. Proper dry matter content is important as it relates to how tightly the crop will pack in the storage structure, quickly exclude oxygen, and undergo a favorable fermentation. Silages harvested too dry (greater than 38% dry matter), do not pack tightly and often times do not ferment correctly and excessively heat at feedout. Silages harvested too wet (less than 28% dry matter) may undergo a butyric-type fermentation which can decrease feed intake and increase the incidence of ketosis in early lactation cows.

Storage type	Expected % dry matter (DM)	Cautions
Dry hay- stored inside	88 - 92%	
Dry hay- Stored outside	88 - 92%	Stored uncovered- (usually lower dry matter because hay absorbs moisture from atmosphere often times 85% or less
Silage- stored in bunkers/piles	32 - 38 %	**Less than 30% DM**—may limit intake **Greater than 38%** DM -- may not ferment and pack as well as slightly wetter silage
Silage- stored in bags	35 – 38 %	
Silage- stored in uprights	35 – 38 %	

- **Energy Content:** Lactating dairy cows require a tremendous amount of energy to support the energy needs for milk production. In addition, energy is the hardest nutrient to provide in adequate amounts and often times is the most expense nutrient (2.5 times the cost of protein) in diets (corn currently being marketed around $7/bushel). The cheapest source of energy is that provided through the forage portion of the diet.

Energy content of forages is not directly measured in a forage laboratory. These labs use mathematical equations to calculate energy content and each laboratory has their own variation of this equation. Thus, comparing energy values of forages between laboratories can be problematic.

- **Fiber Content:** For consistency between forage testing laboratories, acid detergent fiber (ADF) and/or neutral detergent fiber (NDF) content can be used to evaluate the quality of forages. Most certified forage testing laboratories use a standardized procedure to measure these fiber fractions. These numbers ultimately relate to the amount of energy available to support milk production, growth, immune function, and reproduction. The ADF content reflects the digestibility and amount of energy cattle can obtain from the forage. The NDF content reflects the potential intake of this forage. **As the fiber content increases (both ADF and NDF), the digestibility, energy content, and potential forage intake decreases.** These changes in fiber content ultimately affect milk production or growth rates and profitability. Increasing fiber content (ADF and NDF) decreases energy intake, potential forage intake, and milk production or growth. Protein content is a distant second in importance to fiber content when determining the quality of forages.

- **Compare samples on a dry matter basis:** When comparing forages, comparisons for nutrient content should always be made on a dry matter basis. This allows one to compare across different lots of hay, varieties of corn silage, or other types of forages. The concentration of any nutrient always should be greater when expressed on a dry matter basis compared to an as-fed basis.

- **Relative Feed Value:** For hay (alfalfa, grass, or mixtures), relative feed value (RFV) is an index that compares the quality of a tested hay sample to that of full-bloom alfalfa hay which has been assigned a value of 100. Only the ADF and NDF content of the hay are used to calculate the relative feed value of the hay. The protein content of the hay is not reflected in the relative feed value. **Within a type of hay, as the RFV increases, the quality of the forage also increases.** For lactating dairy cows, we would like the RFV of alfalfa hay to be greater than 170. Because alfalfa generally contains less fiber, alfalfa hay generally has a higher relative feed value than grass hay at the same relative stage of maturity.

Comparing Your Forage Analysis To Average Values

To judge whether your forages are of high quality, they should test better than the average “book values” for this forage. Table 2 shows the average values for large numbers of forage samples collected throughout the US and analyzed by Dairy One Forage Testing Laboratory between May 2022 and April 2023). For ADF and NDF concentrations, values for your forages should be **lower** than the averages for better quality forage than the average. Values should always be compared on a dry matter basis.

Table 2. Average nutrient content for selected forages.				
Forage	Average dry matter (%)	Average ADF (%)*	Average NDF (%)*	Average Crude Protein (%)*
		----------Dry matter basis----------		
Legume Hay	90.7	29.90	37.3	21.2
Mixed Legume Hay	91.5	34.5	47.3	17.8
Mixed Grass Hay	92.8	38.2	60.0	11.2
Wheat Hay	91.6	34.8	57.5	8.6
Wheat Silage	38.1	36.5 (33.1- 39.9)	56.4 (51.6-61.2)	13.7 (10.7-16.7)
Corn Silage	35.1	24.7 (21.5-27.9)	41.4 (36.6-46.2)	8.4 (7.4-9.4)**
* Values in parenthesis represent +/- 1 standard deviation from average ** For Corn Silage tested by this lab- NDF digestibility at 30 hr = avg. 55.7% (range 51.9-59.4%) Data from Dairy One Forage Testing Lab representing samples analyzed from 5/1/2022 through 4/30/2023 (additional data, updated nutrient values for current harvest year, and additional forages available at www.dairyone.com)				

Evaluation of Example Forage Analyses

- **Corn silage**:
  Dry matter content (36.0%) is within the expected range for silage stored in a bag. Both the ADF (22.4%) and NDF (41.1%) values are below the averages, indicating a higher corn grain content and, thus, higher energy content than average. This sample reflects an above average quality corn silage. Also, NDF digestibility for a 30-hr incubation time is average for corn silage samples analyzed by this lab.

Date analyzed: Current crop year Identification of forage: **Corn Silage** – stored in a bag		
Key Nutrients to start evaluation	Dry Matter Basis	As Fed Basis
Moisture	0.0 %	64.0 %
Dry Matter	100.0 %	36.0 %
Acid detergent fiber (ADF) (%)	22.4 %	7.2 %
Neutral detergent fiber (NDF) (%)	41.1 %	13.2 %
NDF digestibility at 30 hrs = 56.9%		

- **Alfalfa Hay:** Dry matter content (89.0%) reflects this hay was stored inside and it does not contain an excessive amount of moisture. Both the ADF (28.4%) and NDF (38.1%) values are below the averages listed in table 2. This indicates a little better quality alfalfa hay than average. Also, the RFV is close to the benchmark of 170.

Date analyzed: Current crop year Identification of forage: **Alfalfa Hay**-- Back lot second cutting		
Key Nutrients to start evaluation	**Dry Matter Basis**	**As Fed Basis**
Moisture	0.0 %	11.0 %
Dry Matter	100.0 %	89.0 %
Acid detergent fiber (ADF) (%)	28.4 %	25.3 %
Neutral detergent fiber (NDF) (%)	38.1 %	33.9 %
RFV= 163		

- **Wheat silage:** Dry matter content (26.5 %) is too wet for optimum fermentation and may decrease intake of this forage. Both the ADF (44.8%) and NDF (66.0%) values are higher than average indicating this forage is lower in energy than the average and will likely limit forage intake. This silage is better suited to be fed to dry cows and bred heifers and, for these cattle, may need to be fed with corn silage and/or a higher amount of grain than an average wheat silage sample. Feeding this silage to the milking herd as the sole forage will result in decreased milk production. Even when fed in combination with other higher quality forages, energy density of the diet will be lower and cows, especially early lactation cows, may not milk as well as when fed better quality forages.

Date analyzed: Current crop year Identification of forage: **Wheat silage**		
Key Nutrients to start evaluation	**Dry Matter Basis**	**As Fed Basis**
Moisture	0.0 %	73.5 %
Dry Matter	100.0 %	26.5 %
Acid detergent fiber (ADF) (%)	44.8 %	11.9 %
Neutral detergent fiber (NDF) (%)	66.0 %	17.5 %

Allocation of Forages

Forages should be allocated based on their quality. The highest quality forages should be fed to the early lactation cows, fresh cows, highest production group of cows, and heifers less than 5 months of age. These dairy cattle have the highest nutrient needs and often times have limited dry matter or feed intakes. If the milking herd is not divided into production groups, the highest quality forages should be fed when the highest percentage of the herd is in early lactation.

Allocation of forages based on quality	
Quality of Forage	**Group of Cattle Allocated**
Top	-- Early Lactation Dairy Cows -- Highest production group -- Fresh cows -- Heifers thru 5 months of age (Cattle with highest nutrient needs)
Above Average	-- Mid to later Lactation Dairy Cows -- Heifers 6-12 months of age
Average	-- Heifers over 12 months of age -- Dry Dairy Cows