iGrow®
A Service of SDSU Extension
iGrow.org

livestock

JUNE 2017

SDSU DEPARTMENT OF
SDSU EXTENSION

Hay Analysis: Understanding Relative Feed Value and Relative Feed Quality

Alvaro Garcia | SDSU Extension Agriculture & Natural Resources Program Director

Purchasing adequately priced hay is critical for the success of any livestock operation. The animal category to be fed dictates the forage quality that best matches their requirements. In times of forage shortages such as during a drought, hay sometimes needs to be hauled from significant distances which taxes its cost per ton, and per pound of nutrients supplied. It is thus very important for livestock producers to be able to assess the feed quality of the forage they purchase. Feed quality of hay harvested depends on the maturity of the stand. As maturity approaches, structural carbohydrates, as measured by the ADF and NDF fractions, increase in the plant. These fractions represent the more indigestible parts of the plant. As a result, digestibility and energy obtained through fermentation decrease with maturity.

Relative feed value (RFV) compares the quality of legume and legume/grass hays. Having one index to price hay and predict animal performance has been very useful for livestock producers and hay farmers.

Relative Feed Value (RFV)

Relative Feed Value estimates digestible dry matter (DDM) of alfalfa from ADF, and calculates the DM intake potential (% body weight, BW) from NDF. The index is then calculated as DDM multiplied by dry matter intake (DMI as a % of BW) and divided by 1.29. This index ranks forages relative to the digestible DMI of full bloom alfalfa, assuming 41% ADF and 53% NDF.

Example: Alfalfa hay or haylage with 32% ADF and 40% NDF
(Plug in values for ADF and NDF on a dry matter basis)

DDM = 88.9 - (0.779 x 32) = 63.97
DMI = 120 / 40 = 3
RFV = (63.97 x 3) / 1.29 = 149

The RFV index is 100 at this growth stage.

DDM = Digestible Dry Matter = 88.9 - (0.779 x % ADF)
DMI = Dry Matter Intake (% of BW) = 120 / (% NDF)
RFV = (DDM x DMI) / 1.29

where the numerator 120, in the DMI calculation above indicates maximum feed intake in alfalfa-based dairy rations when NDF is 1.2 lb per 100 lb of body weight; the divisor, 1.29 in the RFV calculation was chosen so that the RFV of full bloom alfalfa has a value of 100.

Relative Feed Value reflects digestibility (from % ADF) and intake potential (from % NDF).

Limitations of the RFV method:

1. DDM and DMI are assumed constants for all forages.
2. ADF and NDF are the only laboratory values used in the calculation.
3. Crude protein concentration of forage is not used.
4. RFV cannot be used in ration formulation or evaluation.

Higher RFV values indicate higher forage quality. Since the RFV system was developed using legume forages and intake responses of lactating dairy cows, it works best when applied to that situation.

Relative Forage Quality (RFQ)

Relative feed value is calculated by estimating the digestibility of the forage dry matter, and how much the cow can eat based on its "filling" capacity. However, cows sometimes perform differently even when fed forages of identical RFV. Variations in the digestibility of the NDF fraction can probably account for these differences.

Fiber from grass and legumes naturally differs in digestibility, as it also does when grown under different ambient temperatures. RFV of first-cutting alfalfa will be similar to that of second and third cuttings harvested at similar stages of maturity. However, the fiber fraction digestibility from each cutting will be different, as it is influenced by ambient temperatures at the time of growth and development. Therefore, differences in fiber digestibility are not taken into account in the RFV calculation and cows may perform differently when fed forages from different cuttings.

Researchers at the University of Wisconsin have designed the relative forage quality (RFQ) index that uses fiber digestibility to estimate intake as well as the total digestible nutrients (TDN) of the forage. The RFQ index is an improvement over the RFV index for those that buy and sell forages, and it better reflects the performance that can be expected from cattle fed those forages.

One other advantage of the RFQ prediction is that it differentiates legumes from grasses. The higher neutral detergent fiber in grasses will make RFQ a better predictor of quality than RFV. The RFQ emphasizes fiber digestibility while RFV uses digestible dry matter intake. Although grasses have higher fiber fractions (ADF and NDF), they also have lower lignin content.

A comparison of data generated by SDSU showed that the RFQ is slightly higher than RFV for the same sample. A relationship between RFV and RFQ derived from that data set is presented in Figure 1.

The RFV generally penalizes grasses because of the higher fiber fraction compared with alfalfa. The RFQ credits grasses because the grass fiber tends to be more digestible than alfalfa fiber.

Relative Forage Quality Calculation

In the RFQ calculation total TDN substitutes for DDM. Intake and TDN are calculated from fiber digestibility obtained in the laboratory. Relative feed value continues to be widely used as an index to assess quality, compare forage varieties, and price forages. However, differences in the digestibility of the fiber fraction can result in a difference in animal performance when forages with a similar RFV index are fed.

The RFQ index has been developed to overcome this difference. This index takes into consideration the differences in digestibility of the fiber fraction and can be used to more accurately predict animal performance and match animal needs. Although hay base prices vary with supply and demand, the market premium for quality is fairly constant. Long-term auction data indicate that the premium for quality forage is worth $0.90/ton as RFQ changes from one value to another; therefore improving RFQ of harvested forage can improve profitability.

For RFQ:

RFQ = (DMI, % of BW) * (TDN, % of DM) / 1.23

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

Calculations to estimate TDN and DMI for alfalfa, clover, and legume/grass mixes are as follows:

For TDN:

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

Where:

CP = crude protein (% of DM)

EE = ether extract (% of DM)

FA = fatty acid (% of DM) = ether extract - 1

NDF = 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 DM) = 100 - (NDFn + CP + EE + ash).

For DMI:

DMI = 120/NDF + (NDFD - 45) * .374 / 1350 * 100

Where:

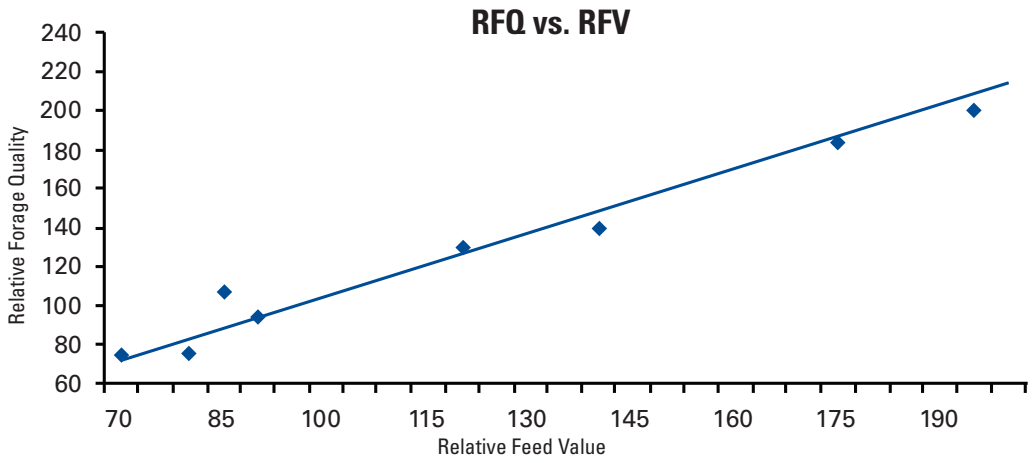
DMI is expressed as % of body weight (BW)

NDF as % of DM

NDFD as % of NDF

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

Fig 1. Relative Forage Quality versus Relative Feed Value.



Publication: 02-2006-2017