By P.H. ROBINSON and C.A. OLD*  

A LFAFA hay has been an important feed in dairy cattle rations in California for a very long time. Indeed, it can be and has been argued that the availability of high-quality alfalfa hay allowed the dairy industry in California to become established.

Alfalfa hay is, in some ways, a unique dairy feed as it combines a number of beneficial nutritional attributes that are seldom found in the same feed. However, the key nutritional (feeding) characteristic of California alfalfa hay and the basis upon which its price and traded in California is its total digestible nutrient (TDN) content.

TDN is a very old term, dating to the late 1800s, that was developed to assess the feeding value of animal feeds. Originally based on the assays of the “proximate system” of analysis, i.e., crude protein (CP), crude fiber (CF), nitrogen-free extract (NFE) and crude fat, this TDN equation was used for almost a century to assess the feeding value of feeds destined for animals. However, determining the TDN content of feeds on the farm on a routine basis is not practical because one had been widely used for many years and the development of equations that are based on research conducted by Drs. Jim Meyer and Glen Lofgreen of the UC-Davis Extension Publication and because the history of these two equations since the data sets used to derive the equations affect their utility.

The purpose of this article is to trace the history of these two equations of particular note in the late 1800s, that was developed for animal feeding should not be lost to time.

Methods

Prediction of alfalfa hay TDN from modified crude fiber (MCF). In Bath and Marble (1989), the equation to predict TDN from MCF (their equation 2) was listed as:

TDN (% of DM) = 81.07 - (0.8558 x MCF (% of DM))  

Bath and Marble stated the basis of this equation to be: “research at the University of California in the 1950s.” Indeed, this equation is based on research conducted by Dr. Jan Meyer and Glen Lofgreen of the UC-Davis department of animal science and Dr. Vern Marble of the UC-Davis department of plant science titled “Testing Alfalfa for its Feeding Value.” In this booklet, a number of equations were presented to predict the TDN, net energy of lactation and digestible dry matter (DM) content of California alfalfa hay from single analytes of the hay. Among these equations, there are two TDN equations of particular note because one had been widely used in the California dairy industry from the 1960s through the 1980s, and the other became widely used after publication of the Western Regional Extension Publication and remains in widespread use today. The purpose of this article is to trace the history of these two equations since the data sets used to derive the equations affect their utility.

Obviously, assaying for a single analyte is much less complex than completing a digestibility experiment with cattle or sheep, and this makes it a practical approach for routine, on-farm prediction of the TDN level of specific lots of feedstuffs. This was the approach taken by Meyer and Lofgreen (1959), where the use of a single analyte to estimate quality supplemented the visual appraisal methods used at that time. In 1989, a Western Regional Extension Publication was co-authored by Dr. Don Bath of the University of California-Davis (UC-Davis) department of animal science and Dr. Vern Marble of the UC-Davis department of plant science titled “Testing Alfalfa for its Feeding Value.” In this booklet, a number of equations were presented to predict the TDN, net energy of lactation and digestible dry matter (DM) content of California alfalfa hay from single analytes of the hay.

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New indications:

- Cows or heifers being vaccinated should be vaccinated prior to breeding, within the previous 12 months, with any of the vaccines in this product line.
- Fetal health risks associated with vaccination of pregnant animals may be reduced by their use of the MLV vaccines should always be discussed with a veterinarian.

In 60 seconds

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- Cows or heifers being vaccinated should be vaccinated prior to breeding, within the previous 12 months, with any of the vaccines in this product line.
- Maternal management strategies based on vaccination of pregnant animals may be reduced by the use of MLV vaccines should always be discussed with a veterinarian.
- Cows or heifers being vaccinated should be vaccinated prior to breeding, within the previous 12 months, with any of the vaccines in this product line.
upon which alfalfa hay is valued and traded in California and surrounding states.

It is likely that the many hundreds of millions of dollars of alfalfa hay traded annually at prices based on the alfalfa hay TDN value estimated by this equation and its widespread use in the southwestern U.S., especially in California — continues.

Discussion

The first stop in our quest was a discussion with Dr. Vern Marble, retired in Davis, who is certain that the equation was developed by either Bath or Garrett based on digestibility studies completed by Garrett at UC-Davis in the 1980s and, possibly, by Dr. Warren Speth of the University of Nevada with whom Garrett conducted joint research under the auspices of a USDA regional research project. However, Marble was adamant that he had not created the equation.

The next stop was Dr. Don Bath, who recently passed away. Examination of original paper drafts of the 1989 Bath and Marble publication revealed that their equation 7 had originally been a different one (referred to by Marble in equation 7 had originally been a different one (referred to by Marble in equation 7), the “western states equation” and the “California alfalfa TDN equation”?

In order
1. It is extremely unlikely that the exact data set used to develop equation 7 will ever be identified.
2. It is barely short of a certainty that equation 7 was based on the alfalfa digestibility data from cattle at maintenance derived by Bath at UC-Davis in the 1980s.

The final stop was Dr. Bill Garrett, also retired in Davis. Remarkably, Garrett has maintained all of his original digestibility data from the 1980s in computer files and kindly shared them with us. Garrett was aware of the 1989 Bath and Marble publication and its equation 7 and was certain that it was based on his data — data that represent a total of 52 lots of alfalfa hay and cubes that were used in studies with cattle at maintenance (11 lots), cattle at production levels (four lots), sheep at maintenance (17 lots) and sheep at production levels (20 lots).

Regarding TDN, Garrett said it is interesting that TDN use has persisted to this day since digestible energy is more highly related to ADF than TDN was. However, our independent efforts with this data set to recreate equation 7 were not successful, although the TDN prediction equation based on the 11 lots of hay fed to cattle at maintenance is very close to equation 7.

So, what can be concluded about the origin of equation 7, later referred to, variably, as the “WRP 109 equation,” the “western states equation” and the “California alfalfa TDN equation”? It is likely never be known with certainty.

However, it is almost certainly an equation based on feeding studies with cattle fed at maintenance intake levels completed in the 1980s at UC-Davis. As such, it is the only TDN (or feed energy) prediction equation used commercially in the U.S. that is directly based on data developed from live animal studies.

References


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