

The 2001 edition of the US National Research Council's 'Nutrient Requirements of Dairy Cattle' made a significant change in the method used to estimate the energy content of feeds. Past editions assigned TDN (Total Digestible Nutrient) values to feeds based on animal feeding experiments. Concentrations of digestible energy (DE), metabolizable energy (ME) and net energy of lactation (NE_l) were calculated from the measured TDN values. TDN content of feeds was measured in animals fed at maintenance levels of energy intake. Dairy cows consume 2 to 4 times more energy during lactation than they do when dry. The energy value of the feed was reduced by approximately 4 to 12% at these high levels of feed intake because the increased passage rate of feed through the digestive tract reduced the amount of energy the cow could extract from the feed.

The NRC Dairy Committee has pointed out the problems with this approach:

- Most of the TDN values in feed composition tables were determined in experiments done many years ago. The nutrient composition of many of these feeds has changed over the years with feed composition tables being updated to reflect many of these changes. However, TDN values have either not been adjusted, or have been estimated using equations, rather than being experimentally determined.
- TDN values of many feeds are difficult to measure directly since they cannot comprise the majority of the diet. Inaccuracies occur when we try to determine the proportion of the TDN being contributed by each component of a mixed diet.
- Few DE, ME and NE_l values have been determined on individual feeds in animal experiments. Most have been calculated from TDN values.
- The NE_l concentration in a feed is not constant, it decreases as feed intake increases. Many feed composition tables and ration formulation programs do not take this into account or they simply reduce the NE_l book value by 8%. The 8% discount assumes that all cows are consuming 3 times their maintenance energy requirement whereas average energy intake of a herd may range from 2 to 4 times maintenance.

NRC 2001 Feed Energy Predictions

To try to overcome some of these problems the NRC Committee has suggested that TDN content be calculated from the chemical composition of the

feed. With this method the feed is analysed to determine its content of non-fibre carbohydrate (NFC), crude protein (CP), neutral detergent fibre (NDF) and crude fat (CF). The true digestibility of each of these fractions is then calculated using a set of equations. TDN at maintenance level (1x) of intake is calculated by summing the true digestibility of each of the chemical components (see sidebar below).

To account for the reduction in energy content of feeds at high levels of feed intake, TDN levels can be reduced by 4% for each one-fold increase in energy consumption above maintenance. For example, cows consuming twice as much energy as they would at maintenance would have the energy level in the diet reduced by 4% whereas cows consuming 4 times maintenance would have dietary energy concentration reduced by 12% (3 x 4%).

Many ration balancing programs use DE, ME or NE_l to calculate the energy content of the diet. The 2001 edition of the Nutrient Requirement of Dairy Cattle provides equations to calculate these energy values and the method used is the same as described for estimating TDN.

Estimation of forage TDN at maintenance (TDN_{1x})

- truly digestible non-fibre carbohydrates (tdNFC)
= $0.98 \times (100 - [(NDF - NDICP) + CP + CF + Ash])$
- truly digestible crude protein (tdCP)
= $CP \times \exp[-1.2 \times (ADICP / CP)]$
- truly digestible fatty acids (tdFA)
= $CF - 1$
- truly digestible neutral detergent fibre (tdNDF)
= $0.75 \times [(NDF - NDICP) - \text{Lignin}] \times (1 - [\text{Lignin} / (NDF - NDICP)])^{0.667}$

$$TDN_{1x} (\%) = tdNFC + tdCP + (2.25 \times tdFA) + tdNDF - 7$$

TDN: Total Digestible Nutrients

NDF: Neutral Detergent Fibre

NDICP: Neutral Detergent Insoluble Crude Protein

CP: Crude Protein

CF: Crude Fat (Ether Extract)

ADICP: Acid Detergent Insoluble Crude Protein

To make use of this method for estimating energy content of feeds, the following chemical analyses are required: CP, NDE, NDICP (neutral detergent insoluble crude protein), ADICP (acid detergent insoluble crude protein), lignin, ash and crude fat (CF).

This is likely to become the method of choice for estimating energy content of feeds for which we do not have reliable measures of energy content. Pea silage and pea grain are two examples of feeds for

which few experimentally derived energy values are available. The energy content of most forages is currently estimated by measuring ADF content and plugging this into a 'best fit equation'. The problems with this approach were discussed in the Winter 2000 issue of Western Dairy Digest (p 5). Time and experience will tell if the new NRC 2001 approach will be an improvement.

source: Rick Corbett, Dairy Research and Technology Centre