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CLAYTON LIVESTOCK RESEARCH CENTER

PROGRESS REPORT

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Predicting Intake by Beef Cattle - Relationship of Energy Intake to Dietary Energy Concentration

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Factors that regulate dry matter intake by ruminants are complex and not understood fully. Hence, equations for predicting dry matter intake by beef cattle are generally empirical in nature. Nonetheless, accurate predictions of feed intake are vital to application of equations for predicting nutrient requirements of beef cattle. Previous research has established relationships between dietary energy concentration and dry matter intake by beef cattle, and the general belief is that consumption of low-energy (often high fiber) diets is controlled by physical factors like ruminal fill and digesta passage, whereas consumption of high-energy (often low fiber, high concentrate) diets is controlled by energy demands of the animal and metabolic factors (NRC, 1987). The current nutrient requirements for beef cattle (NRC, 1984) provides an equation to predict dry matter intake by growing/finishing steers. This equation describes dry matter intake as a function of dietary NEm concentration, with additive adjustments for frame size and(or) sex. The basic equation is as follows: daily dry matter intake (kg) = $BW^{.75}$ x (.1493 x NEm - .046 x NEm^2 - .0196), where BW is body weight in kg and NEm is expressed as Mcal/kg of dry matter. Our objective was to use data from the published literature to reevaluate the relationship between dietary NEm concentration and dry matter intake by growing finishing beef cattle.

Data were obtained from experiments published in the Journal of Animal Science from 1980 to 1992 that were conducted with growing/finishing beef cattle. Each of the 184 data points extracted from the literature represented a treatment mean for average dry matter intake throughout a feeding period. Feeding periods typically were 56 days or longer. Information on frame size (small, medium or large), sex (steer, heifer or bull), age (calf vs yearling), and initial and final body weights was recorded. Dietary NEm concentration was calculated from tabular values (NRC, 1984); however, actually determined NEm values were used if available. Because of limited numbers of observations, bulls were classed as large-framed steers, and large-framed heifers were classed as medium-framed yearling heifers. Total NEm intake was calculated as the product of dry matter intake and dietary NEm concentration. Total NEm intake was then divided by average metabolic body weight (MBW = average $BW^{.75}$). The intake of NEm per unit MBW was analyzed by stepwise regression procedures (SAS, 1987) with dietary NEm concentration, NEm^2 and dummy variables used to account for effects of sex and frame classes as possible independent selections.

The relationship between NEm intake per unit MBW and dietary NEm concentration is shown in Figure 1. A regression equation including NEm, NEm^2 and an intercept adjustment for yearling cattle accounted for 69.87% of the variation in NEm intake per unit MBW. Expressed as total NEm intake (Mcal/day), this equation was as follows: NEm intake (Mcal/day) = $BW^{.75}$ x (.2435 x NEm - .0466 x NEm^2 - .1128). For medium-framed yearling steers and medium-framed yearling heifers, the intercept term would be -.0869 instead of -.1128. Dry matter intake (kg/day) can be calculated by dividing total NEm intake (Mcal/day) by dietary NEm concentration (Mcal/kg).

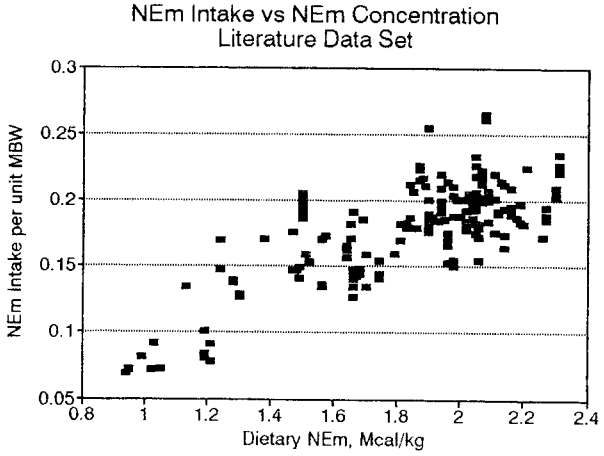

Figure 1. Relationship of dietary NEm concentration to NEm intake by beef cattle. Data points were obtained from published literature and represent treatment means for average intake during a feeding period.

Dry matter intake predicted from the equation given above and from the NRC (1984) equation were regressed on actual dry matter intake for the 184 data points. The NRC-predicted intake accounted for 62.35% of the variation in dry matter intake, with a bias of -2.2% (under prediction). Dry matter intake predicted from the new equation accounted for 72.85% of the variation in actual dry matter intake, with a bias of -1.86%. An additional data set, supplied by Dr. Danny Fox of Cornell University (74 data points; average dry matter intake for small-, medium-, and large-framed steers and heifers; NEm [Mcal/kg] ranged from approximately 1.4 to 2.1), was used as an independent test of the new equation. For this independent data set, the NRC-predicted dry matter intake accounted for 54.39% of the variation in actual dry matter intake, with a bias of + 9.12% (over prediction). The new equation

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accounted for less variation in actual dry matter intake (39.57%), but had less over-prediction bias (+3.02%) than the NRC (1984) equation.

A comparison of the dry matter intake predicted from the NRC (1984) equation, and the new equation is shown in Figure 2. In this example, dry matter intake was predicted for a 410-kg average body weight, medium-framed steer (300 and 520 kg initial and final body weights, respectively) over a range in NEm of 1 to 2.35 Mcal/kg. At low dietary NEm concentrations, both equations yielded similar estimates of dry matter intake. The new equation predicted lower intakes in the middle of the energy range, and higher intakes at the upper end of the energy range, than the NRC (1984) equation.

Further testing of the new equation with independent data sets will be required to determine whether it offers a better predictive tool than the NRC (1984) equation. Feed intake can vary greatly with environmental conditions, management factors, cattle type and dietary factors. Hence, any equation should be viewed as providing a guideline instead of an absolute prediction of intake. Feedlot managers and nutritionists should use such guidelines along with their own data base to develop more accurate predictions for specific situations.

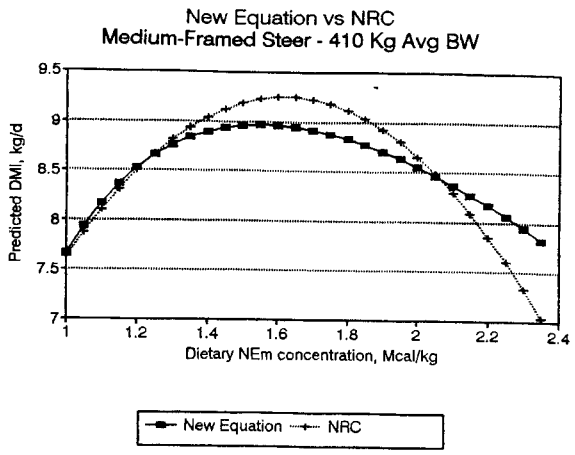

Figure 2. Comparison of dry matter intake predicted from the NRC (1984) equation with that predicted from the equation developed from a literature data set.

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