Estimating Digestible Energy from Digestible Dry and Organic Matter in Diets of Grazing Cattle[1]

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Highlight

Regression equations for six methods of expressing the relationship between digestible energy and digestible dry or organic matter were developed from digestion trials conducted with cattle grazing native range forage. Concentrate feeds supplemented the grazing animal's diet in some trials. The results of this study indicated that the laborious determination of digestible energy could be replaced by a simple determination of digestible dry or organic matter. Supplementation with concentrates did not change the relationship between digestible energy and digestible dry or organic matter.

Moir (1961) showed the close relationship between digestible dry matter and digestible energy in ruminant diets by summarizing data from the literature involving hand fed feedstuffs. The objective of the present study was to examine the relationship between digestible energy and digestible dry or organic matter when determined under range conditions.

Experimental

Data from five independent studies were obtained from digestion trials conducted with cattle grazing native

Table 1. Trial locations, number of observations per trial, season of use and supplementary regimen.

Trial location	Number of observations	Season of use	Supplementary regimen
SB[a] 1964	3	Early summer	None
SB 1964	4	Early summer	None
SB 1964	4	Mid summer	None
SB 1964	5	Mid summer	None
SB 1964	6	Late summer	None
SB 1964	6	Late summer	None
SB 1965	5	Early summer	None
SB 1965	5	Early summer	None
SB 1965	5	Mid summer	None
SB 1965	3	Mid summer	None
SB 1965	3	Late summer	None
FR[b] 1966	5	Winter	None
NP[c] 1967–8	14	Winter	Yes
NP 1969	7	Winter	None
NP 1969	7	Winter	Yes

[a] Scotts Bluff Experimental Range
[b] U.S.D.A. Beef Cattle Research Station at Fort Robinson
[c] University of Nebraska North Platte Station

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Table 2. Estimated linear regression parameters, using the model $y = a + bX$, with their respective standard errors and the estimated standard error of estimate ($s_{y \cdot x}$) and coefficients of determination (r^2).

Comparison	Regression parameter			
	a	b	$s_{y \cdot x}$	r^2
DE vs DMD	0.54 ± 1.41	1.02 ± 0.03	2.32	.939
DE vs OMD	−8.13 ± 1.06	1.07 ± 0.02	1.51	.956
Kcal DE/g DM vs DMD	0.18 ± 0.07	0.038 ± 0.001	0.195	.891
Kcal DE/g DM vs OMD	−0.10 ± 0.08	0.039 ± 0.002	0.118	.891
Kcal DE/g OM vs DMD	0.04 ± 0.09	0.048 ± 0.002	0.142	.903
Kcal DE/g OM vs OMD	−0.36 ± 0.08	0.050 ± 0.002	0.120	.917

range (Streeter, 1966; Rittenhouse et al., 1970). The forages studied represented a wide range of phenological development. Some of the animals also received from 6.1 to 24.5 g of a concentrate supplement per kg metabolic body weight $(BW)^{0.75}$. Trial locations, number of observations per location, season of use, and supplementary regimen are given in Table 1.

Digestible dry and organic matter were estimated using lignin as an internal indicator as described by Rittenhouse et al. (1970). Lignin was determined by the procedure outline by Van Soest (1963) in trials at the Scotts Bluff Experimental Range, and by Van Soest and Wine (1968), as modified by Rittenhouse et al. (1970), in all other trials. Samples of the diet were collected via esophageal fistulae and total fecal collections were obtained from animals equipped with harnesses and bags.

In order to establish the most desirable means of expressing the relationship between dry matter digestibility (DMD) or organic matter digestibility (OMD) and digestible energy (DE) six comparisons were made:

% DE	vs	% DMD
% DE	vs	% OMD
kcal DE/g DM	vs	% DMD
kcal DE/g DM	vs	% OMD
kcal DE/g OM	vs	% DMD
kcal DE/g OM	vs	% OMD

In developing regression equations for the six methods of comparing DMD or OMD with DE, the data were analyzed according to the linear model $Y = a + bX$. Data within each location and year were grouped for purposes of regression. Homogeneity of regression coefficients for each location and year was tested by an appropriate F test in an analysis of covariance. Predicted or adjusted values were also tested in an analysis of covariance. The influence of supplements on the relation between digestible energy and digestible dry or organic matter was also evaluated by testing adjusted means in an analyses of covariance.

Results and Discussion

The test for homogeneity of regression coefficients among trials indicated no significant differences at the 0.05 level of probability for comparisons involving either dry matter or organic matter. Likewise, no differences ($P > .05$) were found among predicted or adjusted values. Including supplements in the dietary regimen did not significantly ($P > .05$) alter the predicted or adjusted values. Estimated linear regression parameters, their respective standard errors, standard errors of estimate ($s_{y \cdot x}$) and the coefficients of determination (r^2) are shown in Table 2.

Slightly more of the total variation was accounted for when digestible energy was compared with OMD vs DMD ($r^2 = .956$ and .939, respectively), but the precision of estimating a pre-

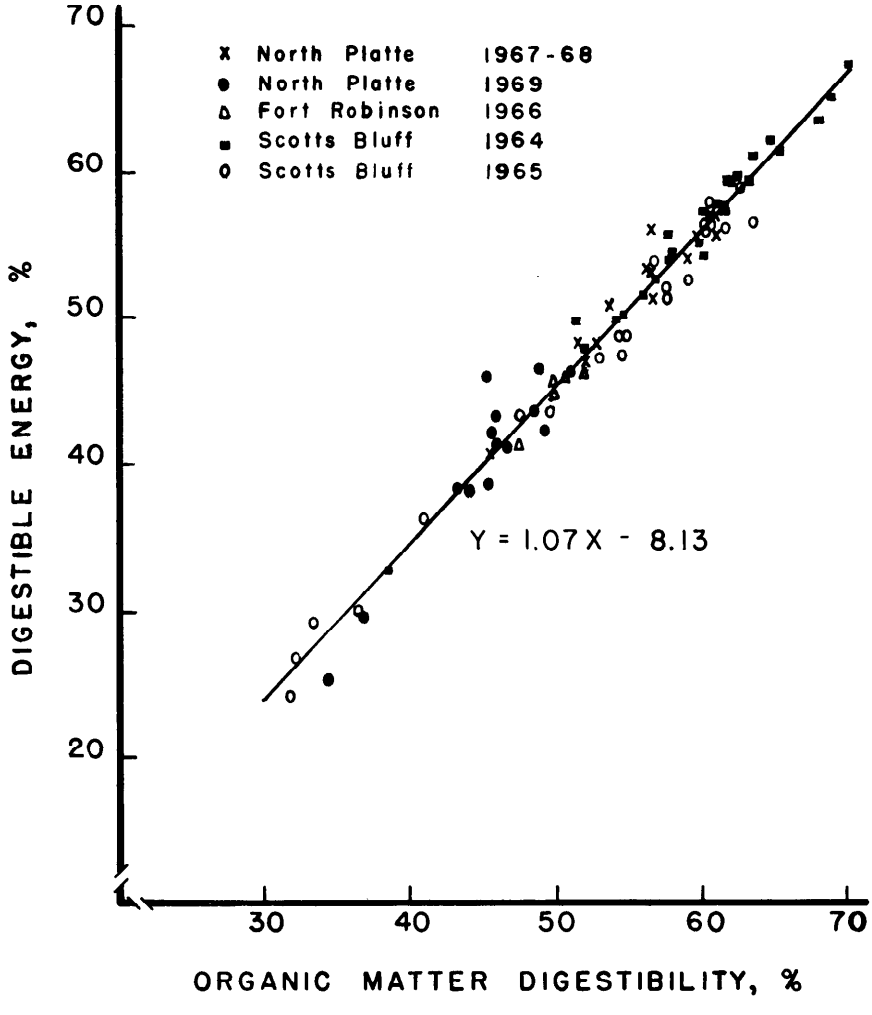

FIG. 1. Relationship between digestible organic matter and digestible energy determined in grazing trials.

dicted value was much higher with OMD ($s_{y \cdot x} = 1.51$ and 2.32, respectively, Table 2). Samples collected via esophageal fistulae are known to be contaminated with soil and salivary ash to varying degrees (Van Dyne and Torell, 1964); however, a comparison of slopes of the regression lines for DE vs DMD and OMD indicated that the variable ash content of the diet had little influence on energy digestibility. Expressing digestible energy as a percent was superior to an expression as a content of dry or organic matter. The close relationship between digestible energy and digestible organic matter is shown in Figure 1. All but three of the points fall on or within a 95% confidence interval of the estimate of a population individual.

Even though digestible energy was predicted with less precision from DMD than OMD, the parameters would suggest that DMD is an excellent estimate of the digestible energy intake of a grazing animal. For all practical purposes the Y intercept was found to be at zero and the slope of the regression line was a 1 : 1 ratio between digestible energy and DMD, i.e., $Y = 1.02X + 0.54$. This agrees well with the equation given by Moir (1961): $Y = 1.006X - 2.013$ where Y was percent digestible energy and X was percent DMD. A similar agreement was found between the present work and the equation given by Moir (1961) when digestible energy was expressed as a content of dry matter ($Y = 0.038X + 0.18$ and $Y = 0.046X - 0.192$, respectively). These findings suggest that either DMD or OMD may be used with the above equations for predicting DE of similar type native range forage.

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