RELATIONSHIPS BETWEEN PROTEIN, ENERGY AND PROTEIN VALUE AT NITROGEN EQUILIBRIUM IN SHEEP

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Introduction

The relationship between optimum protein and energy levels at maintenance has been shown to be constant. Most digestion and metabolism trials are conducted with protein and/or energy above this maintenance level. This study examined a large number of individual nitrogen balance trials to compare biological values as calculated conventionally with those determined using the constants obtained at nitrogen equilibrium. The results were used to establish requirement values for protein and energy for maintenance.

Materials and Methods

Routine N balance trials were conducted with feces and urine collection at the Finnish Agricultural Experiment Station. Over 700 individual determinations, representing over 150 different diets were used as the data base. Truly digested N and ME intake at nitrogen equilibrium were calculated by interpolation from actual N balance data. The biological value (BV) was calculated conventionally (BVC) and by equation (BVE). The relationship was:

$$a = \frac{16.76b}{w}$$

where: a = g truly digested N per BW $kg^{.75}$ (MBW) at N equilibrium.
b = ME MJ per MBW at N equilibrium.
w = BV

The relationship between BVE, BVC, N intake, energy intake and a number of measurements of N and energy status were examined by correlation and linear regression analysis.

Results

The mean value for BVE was .44 ± .15 and for BVE was .47 ± .15. The ratio of BVC:BVE was .98. The correlation coefficient between the two values was .7. The truly digested N intake and the ME intake at nitrogen equilibrium were .75 ± .40 g per MBW and .35 ± .14 MJ per MBW, respectively.

Discussion

Although BVE and BVC were relatively close as means, there was considerable variation within experiments. A correlation coefficient of .7 was highly significant, but the ratio of BVC:BVE ranged from .2 to 2.9. Most of this variation (R^2 = .8) was related to the energy intake at nitrogen equilibrium. Measurements of nitrogen intake, digestibility and nitrogen balance were very poorly associated with the differences in the ratio of BVC:BVE between experiments.

The relationship between mean BVE and BVC depends essentially upon the constant in the equation. This value was based on a constant obtained in experiments with intragastrically fed sheep (Asplund, 1985). That constant was 14.7 but was adjusted upward because of the higher endogenous N losses in orally fed, compared to infused sheep.

The ME requirement for maintenance was obtained by examination of the nitrogen balance data. It was .35 MJ per MBW. This compares favorably to the .29 MJ proposed by Brody (1945). In fact, Graham (1967) suggested that the value for sheep was slightly higher than Brodies estimate which is logical since the Brody figure was for fasting heat production and not for maintenance ME. The N requirement when corrected for digestibility and BV can be compared to the protein requirements proposed by NRC (1985).

Regardless of the method of determination, it appears that the amino acids presented to the

tissues are utilized by sheep with an efficiency of less than 50%. Examination of the individual experiments may yield further insight into the factors influencing this utilization.

(Key Words: Protein, Energy, Biological Value)

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