Note on the determination of net protein utilization by carcass analysis

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In theory the measurement of net protein utilization (N.P.U.) refers to the particular protein under test. In practice there is a small amount of other nitrogen (including that from the vitamins) in the basal diet so that the actual measurement evaluates a mixture of test protein and this other nitrogen. In the diets that we have been using with rats (Miller & Bender, 1955; Bender, 1956) the test diet was made up to contain 1·69 % N; the non-protein diet contained 0·05–0·1 % N.

In the subsequent discussion the following symbols are used: I_F, total dietary N, comprising I_P, N from test protein and I_K, other N; F, faecal N; M, metabolic N; U, urinary N; E, endogenous urinary N; B, B_F and B_K, initial carcass N, carcass N of protein-fed animals and of non-protein group respectively.

Our original calculation (Bender & Miller, 1953) evaluated the total nitrogen of the diet, from the equation

$$\text{N.P.U.} = \frac{B_F - B_K + I_K}{I_F}. \tag{1}$$

The difference between this measurement and the N.P.U. of the test protein alone is insignificant except when very low values are being determined. A protein completely unavailable to the body would still have a small positive value, numerically equal to I_K/I_F and entirely due to the other N of the diet.

In the general definition of net protein utilization

$$\text{N.P.U.} = \text{B.V.} \times \text{digestibility}$$

$$= \frac{I_F - (F - M) - (U - E)}{I_F - (F - M)} \times \frac{I_F - (F - M)}{I_F}$$

$$= \frac{I_F - F + M - U + E}{I_F}. \tag{2}$$

If only the test protein is considered, equation (2) becomes:

$$\text{N.P.U. (test protein)} = \frac{I_P - F + M - U + E}{I_P}.$$

Then (according to the procedure of Bender & Miller (1953)) $I_P - F - U$ (instead of $I_F - F - U$) is the gain in N by the protein-fed animal and $= B_F - B$; $-M - E$ (instead of $I_K - M - E$) is the change in N incurred by the non-protein animal and $= B_K - B$. Hence

$$\text{N.P.U. (test protein)} = \frac{B_F - B_K}{I_P} = \frac{B_F - B_K}{I_F - I_K}. \tag{3}$$

The practical difference between equations (1) and (3) is shown in Table 1. With proteins of high N.P.U. the inclusion of the trace of N in the non-protein diet makes very little difference to the N.P.U. of the protein alone (equation (3)). With protein of very low N.P.U., however, as for example gelatin, with an expected N.P.U. of zero (Bender, Miller & Tunnah, 1953) the difference is appreciable.

Table 1. *Effect of corrected calculation on* N.P.U. *determinations of various proteins*

Source of protein	N.P.U. of total nitrogen of diet (equation (1))	N.P.U. of protein only (equation (3))
Dried defatted egg	93·0	92·5
Bread fortified with lysine and threonine	77·6	76·7
Beef powder	64·0	62·5
Sesame meal	57·3	53·7
Meat meal	40·6	38·5
Wheat gluten	31·7	28·8
Heated sesame meal	29·7	23·5
Low-quality fish meal	17·7	12·9
Gelatin	9·4	3·5

SUMMARY

The calculation of net protein utilization by the carcass-analysis method with rats is discussed and a minor modification suggested whereby either the total nitrogen of the diet or the test-protein fraction only may be evaluated.

REFERENCES

Bender, A. E. (1956). *Brit. J. Nutr.* **10**, 135.
Bender, A. E. & Miller, D. S. (1953). *Biochem. J.* **53**, vii.
Bender, A. E., Miller, D. S. & Tunnah, E. J. (1953). *Chem. & Ind.* p. 799.
Miller, D. S. & Bender, A. E. (1955). *Brit. J. Nutr.* **9**, 382.