RUMEN LIQUID TURNOVER AND MICROBIAL YIELDS

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In continuous culture with energy limitation cell yields per unit of substrate metabolised are functions of dilution rate (Stouthamer & Bettenhausen 1973). This has practical applications in the feeding of ruminant animals in which the rumen fermentation can be approximated to a continuous culture and the cell yield constitutes a major source of prot-'ein and other nutrients to the host animal.

Equations governing growth yield as a function of dilution rate are generally in forms, which are inconvenient for practical application. It is suggested that an equation of the form

$$Y = \frac{Y_{max}}{g\,Y_{max} + Y_{max}/(\alpha z + b) + 1}$$

may be a useful first approximation to the behaviour of the energy limited rumen fermentation.

Y = cell yield per unit weight of F.O.M.; Y_{max} cell yield per unit weight of anhydroglucose fermented to provide ATP for biosynthesis; q = the weight of anhydroglucose dissimilated to provide carbon for the synthesis of unit weight of microbial cells; z = feeding rate as times maintenance; α,β = constants governing the relation of dilution rate to feeding rate.

At present it is a matter of conjecture to what degree and under what circumstances the rumen fermentation is under energy or nutrient limit-ation. It can be readily shown, that under the latter conditions "L" the loss of potential cell yield per unit time is given by

$$L = \frac{\mu^2\, V.\, Km}{(K-\mu)r}$$ where

μ = dilution rate (t^{-1}); V = volume; Km = a Michaelis constant governing the growth response to nutrient concentration; K = a rate constant for growth without nutrient limitation; r = the weight of limiting nutrient required to form unit weight of cells.

Thus under nutrient limited conditions increase of dilution rate leads to loss of potential cell yield. Establishment of the nature of the limitation on microbial growth is therefore critical before a large research investment is made in attempts to artifically increase dilution rate (Leng 1981).

The concentration of limiting nutrients "S" under steady state conditions is given by

$$S = \frac{\mu.Km}{(K-\mu)}$$

Comparison of nutrient concentrations in free rumen fluid could be made with values of "S" calculated from K and Km values determined on isolated organisms to make an assessments of the possibility of occurrence of nutrient limitation. At present information on rumen free liquid concen-trations of nutrients and quantitative data on the nutritional responses of rumen organisms is very limited but the observations necessary could be readily made.

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