DEVELOPMENT OF THE CAMDAIRY COMPUTER MODEL

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Jensen *et al.* (1942) reported that milk production per unit of energy input declined with increasing energy intake. Subsequently, many authors have investigated the relationship between milk production and intake of metabolisable energy (ME). Some concluded that it was linear, others that it was curvilinear. In the latter case, the efficiency of milk production is assumed to decrease to a measurable asymptotic yield according to the law of diminishing returns. Broster (1972) assumed that as energy intake increased above maintenance there was increasing partition of energy towards liveweight gain, which was responsible for the apparent law of diminishing returns with respect to milk yield. The CamDairy model (Hulme *et al. 1986)* uses a curvilinear relationship calculated from the data of Jensen *et al. (1942).*

Definition of the milk response to ME for production (ME, is of critical importance for models which attempt to optimise milk production systems. Empirical relationships between fat corrected milk production (FCM), ME, and ME for lactation (ME,) were investigated through analyses of unpublished data from 2 experiments, 1 conducted at the Institute for Grassland and Animal Production (IGAP) in the UK, and the other at the Dairy Forage Research Centre (DFRC) in the USA.

Use of a single requirement (5MJ ME/L FCM) underestimated milk production at low levels of ME, and overestimated milk production at high levels of ME, at both sites. The non-linear model of the relationship between FCM and ME, (Hulme *et al.* 1986) gave underprediction for high values of ME, Within the data range there was no significant difference between the linear and non-linear relationships of ME, to milk production. However, the linear relationships had significant intercepts (10.7 and 6.9 L FCM for IGAP and DFRC respectively) representing 58 and 38% of maintenance respectively. It is possible that when ME intake is between maintenance and twice maintenance, efficiency of milk production is very high, which would result in a bi-modal response. Nutritional management programs such as CamDairy (Hulme *et al.* 1986) are concerned primarily with incremental changes in the energy cost of milk production in the range 1 to 4 times maintenance. We calculated that the average energetic costs of milk production between maintenance and twice maintenance were 2.7 and 4.2 MJ ME_P/L for the IGAP and DFRC data sets respectively, and this increased to 9.6 and 6.7 respectively for intakes of ME, between 3 and 4 times maintenance.

Bines *et al.* (19SS) found that the proportion of ME, used for milk production decreased with increasing level of intake at all stages of lactation. The present study however, showed no indication of an increased partition of energy into liveweight change. While there was an increase in liveweight gain associated with increasing plane of nutrition ($P < 0.001$), the energy being utilised for liveweight gain as a proportion of ME, remained constant ($P < 0.25$). Bines *et al.* (1988) also found that the ME value of liveweight change (ME_G) increased with increasing proportion of concentrate in the diet, although the difference was not significant. Bines *et al.* (19SS) assumed an increase in ME, as a proportion of ME_P based on the assumption that the ME requirement/L of milk remained constant as ME, increased. It is not possible to calculate the value of ME, if the ME requirement for milk is not fixed. It is possible that the partition of ME, between ME, and ME, may vary with increasing ME,. Prolonged genetic selection for milk production may have resulted in a lactational drive such that the supply of additional nutrients, balanced for lactational needs, results in milk being produced with constant efficiency up to the limit of appetite.

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