THE ENERGY METABOLISM OF YOUNG FRIESIAN CALVES FED ON A DIET CONSISTING OF MILK AND MEAL

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ABSTRACT

Two Friesian bull calves were selected from those born each week for six weeks during March and April 1975. The twelve calves were used in an experiment to study the energy metabolism of young calves when fed a milk and meal diet.

1. All calves were reared on fresh whole milk with pelleted concentrate available ad lib. Between 21 and 42 days of age intake was adjusted so that each animal received half of its daily allowance of ME from milk and half from meal. From each pair, one calf was assigned randomly to a high level, and its pair mate consequently to a low level of feeding.

2. Energy and nitrogen balances (seven days duration) were measured once for all pairs of calves and twice for the last three pairs.

3. Heat production (MJ/day) was related to liveweight (kg) by $HP = .200\ LW^{.980}$, and metabolizable energy to liveweight by $ME = .340\ LW^{.922}$.

4. The data for heat production, metabolizable energy intake and energy retention were interpreted to provide estimates of 'true' net energy required for maintenance of 0.26 $MJ/kg^{0.75}$ daily.

5. The pooled values for ME required for maintenance were 0.37 and 0.41 MJ $ME/kg^{0.75}$ daily determined by simple and multiple regression techniques respectively. The net efficiency of utilization of ME above maintenance was 0.63 determined by simple regression.

6. Pooled values for the partial net efficiencies of utilization of ME for the synthesis of protein and fat were 0.38 and 1.00 respectively.

7. ME required above maintenance per kg of liveweight gain was 16.53 and 12.85 for the high and low feeding levels respectively. The difference between these values was not significant and the pooled value was 14.89 MJ ME/kg liveweight gain.

8. Methane losses accounted for less than 2% of GE. The metabolizability (ME/GE) of the combined diet was 78% and DE/ME 0.94.

9. Obligatory losses of N were 0.19 $gN/d/kg^{0.75}$, N maintenance (N_m) was 0.35 $gN/kg^{0.75}$ daily, the digestibility was 81% and the biological value 0.53.

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CHAPTER 1

INTRODUCTION

The energy requirements of the pre-ruminant calf were reviewed by Davey (1974), who drew attention to the considerable variation between the estimates of various workers of the metabolizable energy (ME) required for maintenance, energy costs per unit liveweight gain and efficiencies of utilization of ME above maintenance. Holmes and Davey (1976) subsequently confirmed the much lower estimates of recent workers; Vermorel, Bouvier, Thivend and Toullec (1974); Van Es, Nijkamp, Van Weerden and Van Hellemond (1969) and Johnson and Elliot (1972a, b). Estimates of the energy requirements of ruminant calves have been studied by many workers including Neergaard (1974) and Blaxter, Clapperton and Wainman (1966) and these estimates are considerably higher for maintenance and energy costs per unit liveweight gain than for pre-ruminant calves.

However for calves fed on a diet of milk and concentrate little information is available on the estimates for maintenance, energy costs of liveweight gain or net efficiencies. The following work was carried out for this reason and also to investigate whether the change in efficiency from pre-ruminant to ruminant is a sudden one.

The review of literature begins with a brief outline of the anatomical and physiological development of the rumen. This describes variations in the stages of rumen development, the changes in the nature of the end-products of the rumen digestive process, the ability of the animal to absorb the end-products of digestion and the energy costs of digestion when compared to that of a pre-ruminant. Following this a hypothetical model which attempts to integrate factors controlling voluntary feed intake in the young calf is introduced. Emphasis is given in this Section to factors which modify intake which ultimately effect the energy and nitrogen balance of the animal. The final section covers briefly the importance of techniques used in estimating