EFFECT OF RUMEN DEVELOPMENT ON PROTEIN SYNTHESIS IN LAMBS

J.A. CHAMBERS and R. BICKERSTAFFE

The possibility of altering the body composition of lambs by nutritional means has been reviewed by Black (1974). One way is to feed milk. In milk-fed lambs, dietary protein is used more efficiently for growth than in lambs with a functional rumen (Graham and Searle 1972). Furthermore, three times more energy is required to deposit protein in lambs with a rumen (142 ± 25 kJ ME/g protein) than in milk-fed lambs (51 ± 10 kJ ME protein) (Rattray and Jagusch 1977). Both factors probably contribute to the efficient utilisation of milk, for growth, in milk-fed lambs.

We fed milk or grass to two groups of lambs on an equal digestible energy basis, for 20 weeks, and examined the effect of the diets on growth rates, net whole-body protein deposition, whole-body protein synthesis and protein synthesis in some individual tissues. The objective was to determine whether the diets influenced growth and whether this was manifested through changes in protein synthesis. Whole-body protein deposition was determined from chemical analysis of animals serially slaughtered, and whole-body protein synthesis by infusing continuously, for 6 h, [2.3-^{3}H] - tyrosine and measuring the flux of tyrosine. On termination of the infusion the animals were sacrificed and the rates of protein synthesis in individual tissues determined as described by Waterlow et al. (1980). Since insulin may be involved in stimulating the uptake of amino acids for protein synthesis, plasma insulin levels were also measured.

Over the 20-week period, the liveweight gains (110 g/d) were similar in both groups of lambs but the rate of net whole-body protein deposition was higher in the milk-fed (19.4 g/d) than in the grass-fed (12.6 g/d) animals. At 20 weeks there was no difference in whole-body protein synthesis (151.8 ± 20 g/d, grass-fed; 152.5 ± 15 g/d, milk-fed). There were also no differences in the rates of protein synthesis in skin (17.0 ± 5.8%/d) or intestinal (113 ± 34%/d) tissues, but muscle protein synthesis was lower in the grass-fed (2.35 ± 0.5%/d) than in the milk-fed (3.27 ± 1.29%/d lambs. Rumen protein synthesis was also high (45.0 ± 34%/d) in the grass-fed lambs.

These results show that the rate of net whole-body protein deposition is reduced as the rumen develops, but this is not associated with a corresponding reduction in whole-body protein synthesis. There is, however, in the grass-fed lambs, an increased percentage of whole-body protein synthesis involved in synthesising rumen protein and a reduced percentage in synthesising muscle protein. This probably accounts for the lower rate of net whole-body protein deposition in the grass-fed animals. Plasma insulin levels were also lower in the grass-fed (4 ± 1 μU/mL) than in the milk-fed (24 ± 6 μU/mL) lambs, suggesting that insulin may influence the rate of muscle protein synthesis.

BLACK, J.L. (1974). Proc. Aust. Soc. Anim. Prod. 10: 211.
GRAHAM, N. McC. and SEARLE, T.N. (1972). J. agric. Sci., Camb. 79: 383.
RATTRAY, P.V. and JAGUSCH, K.T. (1977). Proc. N.Z. Soc. Anim. Prod. 37: 167.
WATERLOW, J.L., GARLICK , P.J. and MILLWARD, D.J. (1980). 'Protein Turnover in Mammalian Tissues and the Whole Body'. (North Holland: Amsterdam).

Biochemistry Department, Lincoln College, Canterbury, New Zealand