ENERGY INTAKE, EXPENDITURE AND COST OF LOCOMOTION IN LAMBS

K. OPPONG-ANANE, R.V. BAUDINETTE*, J.C. DIGHTON**, S. LAUBE and J.R. SABINE

Energy expenditure can be determined by the doubly labelled water (DLW) technique which involves the administration of water enriched with deuterium (^2H) and oxygen-18 (^{18}O) followed by the determination of the turnover rates of the isotopes. Since ^2H is removed from the body almost entirely as water, whereas ^{18}O is removed from the body both as water and respiratory CO_2, the difference between the turnover rates of the two isotopes provides a measure of the metabolic rate (Lifson et al. 1955). The rate of decline of the ^2H isotope has been used for the estimation of milk intake in lambs (Dove 1988).

The largely non-invasive nature of the DLW method makes it ideal for use in free-living animals. It has, however, never been used to determine the field metabolic rate (FMR) in lambs. The purpose of this study was to measure metabolizable energy (ME) intake and FMR in lambs during the first 5 days of life by the isotopic dilution method, and to assess the proportion of FMR that is devoted to the cost of locomotion (ECL) in the lambs.

An intramuscular dose of 75 mg of 98.7 atom % ^2H_2O and 150 mg of 96.1 atom % $H_2{}^{18}O$ was administered to three single-born Merino lambs at birth in simulated semi-arid conditions during mid-summer in Adelaide. The ^2H and ^{18}O enrichments in the pre-dose, 2 h and 120 h (day 5) post-dose samples were determined by isotope ratio mass spectrometry. Each lamb wore a pedometer on the upper fore-leg, just below the head of the humerus, for measuring the distance travelled. The accuracy of this technique was validated by the use of a motor-driven treadmill.

Lamb Number	Body mass (kg)	Distance Travelled (km)	ME intake (kJ/d)	FMR (kJ/d)	ECL (%FMR)
1	5.1	2.3	4752	1384	6.50
2	4.4	2.4	4094	1181	7.95
3	4.6	2.7	4332	1422	7.42
Mean ± SE	4.7 ± 0.2	2.5 ± 0.1	4393 ± 192	1329 ± 75	7.35 ± 0.42

The dose of $^2H_2{}^{18}O$ administered to the lambs produced an acceptable isotopic enrichment above the natural abundance by the end of the 5-day experimental period. The ME intake provided by the milk consumed represents 3.3 times the FMR. This indicates that about a third of the ME intake was utilized on daily metabolism leaving a total of 3064 kJ for synthesis in the rapidly growing neonates.

The daily distance travelled by the lambs was significantly higher than what is generally observed where pasture condition is good and watering facilities are readily available. The low proportion of FMR devoted to locomotion in the lambs, despite the long distances travelled, suggests that daily movement generally has little consequence to the overall energy usage in these animals. This seems to be general in all mammals, for example locomotion accounts for a mere 6% of the FMR in an elephant (Altmann 1987).

ALTMANN, S.A. (1987). J. Zool. Lond. 211: 215.
DOVE, H. (1988). Br. J. Nutr. 60: 375.
LIFSON, N., GORDON, G.B. and McCLINTOCK, R. (1955). J. Appl. Physiol. 7: 704.

Waite Agricultural Research Institute, Glen Osmond, South Australia 5064
*Flinders University of South Australia, Bedford Park, South Australia 5042
**CSIRO Division of Water Resources, Glen Osmond, South Australia 5064