

ACETATE METABOLISM IN THE SHEEP HIND LIMB : EFFECTS OF EXERCISE
AND PLANE OF NUTRITION

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Acetate is the principal fuel of respiration in most tissues of the fed ruminant, including resting skeletal muscle (Bell 1980), but there is some doubt about its importance as an energy substrate for exercising muscle. Jarrett *et al.* (1976) observed a marked decrease in net uptake of acetate by hind-limb tissues in walking sheep. However, their animals had not been fed for 20h at the time of experiment when the alimentary supply of blood acetate must have been considerably reduced. Therefore we have reexamined the effect of exercise on hind-limb uptake of blood acetate in sheep fed semicontinuously throughout the experimental period.

Non-pregnant, non-lactating Merino ewes aged 5 years and weighing 35-40 kg were daily fed either 800g chopped lucerne hay:oaten chaff (1:1) or 800g crushed maize:chopped lucerne hay:oaten chaff (2:1:1) in twelve equal portions at 2-hourly intervals. These rations supplied energy equal to about maintenance (M) and 1.5 times maintenance requirements, respectively. At least 2d after placing catheters in a carotid artery and the external iliac artery and vein of one hind limb, experiments were performed on sheep while standing at rest and then walking on a moving-belt treadmill at 0.55 m.s⁻¹ (approx. 2 km h⁻¹) on a 10° slope. Measurements included blood flow and arteriovenous (A-V) differences in blood oxygen and acetate concentrations in the hind limb. Net leg uptake of oxygen and acetate was calculated as : uptake = blood flow X (A-V) difference.

Table 1. Hind-limb metabolism of blood acetate (Mean ± S.E.M.; n=6)

	Rest		Exercise	
	1.0	1.5	1.0	1.5
Plane of nutrition (x M)	1.0	1.5	1.0	1.5
Net uptake (μmol. min ⁻¹)	73 ^a ±16	71 ^a ±15	82 ^a ±14	143 ^b ±16
$\frac{2 \times \text{ac. uptake}}{\text{O}_2 \text{ uptake}}$	0.40 ^a ±0.07	0.40 ^a ±0.11	0.08 ^b ±0.01	0.12 ^c ±0.02

Row means with different superscripts are significantly different (P<0.02)

Our results clearly show that in fed sheep, the net uptake of acetate by skeletal muscle and associated tissues does not decrease during moderate exercise, and if sufficient dietary energy is available, can increase significantly. The observed increase was presumably due to diversion of "surplus" acetate from non-oxidative usage elsewhere in the body (e.g. adipose tissue) to oxidation in exercising muscle. Nevertheless, even in the better fed sheep, acetate supply was greatly exceeded by the increased demand of the hind limb for oxidizable substrate during exercise. Thus acetate uptake could have satisfied no more than 12% of this requirement, assuming its complete oxidation to CO₂ and H₂O.

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