

FATTY ACID METABOLISM OF OVINE SKELETAL MUSCLE AT REST AND DURING EXERCISE

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Traditionally, plasma nonesterified fatty acids (NEFA) are considered a predominant fuel for skeletal muscle in non-ruminant animals (Zierler 1976). However, the significance of plasma NEFA as a fuel for ovine skeletal muscle is unknown. The aim of this study was to determine the contribution of plasma NEFA to the energy metabolism of ovine skeletal muscle.

Six merino ewes were housed in metabolism cages and fed a maintenance ration of lucerne chaff. The gross uptake of NEFA by skeletal muscle was determined using a combination of isotope dilution and arterio-venous difference techniques (Pethick et al. 1981). The tracer NEFA were [$1-^{14}\text{C}$] stearic acid (3 sheep) and [$1-^{14}\text{C}$] oleic acid (3 sheep). Simultaneous blood samples were collected from arterial and hind-limb muscle venous circulations for the measurement of blood NEFA, ^{14}C -NEFA, glucose, lactate, $^{14}\text{CO}_2$ and oxygen concentration during a 5h infusion of [$1-^{14}\text{C}$] NEFA. Similar experiments were performed during a 2h exercise period with sheep walking at 4 km/h on a treadmill.

The blood concentrations of NEFA and gross arterio-venous differences for NEFA and oxygen are shown in the table for sheep at rest and after 60 min and 120 min of exercise. The tracer ^{14}C -NEFA was assumed representative of all NEFA. Values are mean \pm SEM.

State of sheep	Arterial NEFA concentration (mM)	Gross NEFA arterio-venous difference (mM)	Oxygen arterio-venous difference (mM)
Rest	0.043 \pm 0.003	0.008 \pm 0.001	3.663 \pm 0.660
Exercise -			
after 60 min	0.455 \pm 0.121	0.045 \pm 0.005	5.858 \pm 0.781
after 120 min	0.814 \pm 0.156	0.084 \pm 0.010	5.595 \pm 0.952

There was no significant net arterio-venous difference for NEFA at rest or during exercise despite a substantial gross uptake. This implies a simultaneous uptake and release of NEFA and emphasises the need for radioisotopic determination of true NEFA utilisation by skeletal muscle. If completely oxidised, NEFA can account for 5.5 \pm 0.7%, 19.9 \pm 2.1% and 38.0 \pm 4.5% of the oxygen utilised by skeletal muscle at rest and after 60 min and 120 min of exercise, respectively. The actual proportion of NEFA oxidised to CO_2 in skeletal muscle was 41 \pm 7% at rest and increased to 101 \pm 17% during exercise. Assuming complete oxidation, the glucose utilised by skeletal muscle was sufficient to account for 28.2 \pm 3.9%, 24.5 \pm 4.7% and 32.0 \pm 4.0% of the oxygen consumed during rest and after 60 min and 120 min of exercise, respectively.

It is apparent that NEFA represent a minor fuel for resting skeletal muscle but increase in importance during exercise. Glucose potentially is an important fuel during rest and exercise.

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