METABOLISM OF SOME GLUCONEOGENIC SUBSTRATES IN SHEEP DURING EXERCISE

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Sheep can exercise for long periods, during which blood glucose is utilised at an increased rate by working muscle (Pethick et al. 1987). The liver must therefore increase its rate of glucose secretion. This paper presents results to show the potential significance of several gluconeogenic precursors.

Eleven sheep aged 3-5 yr with body weight 35-39 kg were prepared with indwelling cannulae to study splanchnic metabolism using the arterio venous difference technique essentially as described by Katz and Bergman (1969). Experiments were performed at rest or during exercise at 4.5 km/hr for 4 hrs at moderate (0° incline) or 2 hrs at high (9° incline) intensity. The latter workload resulted in near exhaustion. The daily ration was 700 g of lucerne cubes fed semicontinuously. Hepatic blood flow (l/min, mean ± s.e.m.) and hepatic arterial contribution to blood flow (%) were 1.91 ± 0.15 and 16, 1.28 ± 0.05 and 5 and 1.38 ± 0.07 and 5 for animals at rest or during exercise of moderate and high intensity respectively. Time dependent changes were not apparent. Results for metabolite concentration ([A], mM) and exchange by the liver (Exchange, mmol/hr) are shown below.

	Glucose		Lactate		Pyruvate		Glycerol		Alanine	
	[A]	Exchange	[A]	Exchange	[A]	Exchange	[A]	Exchange	[A]	Exchange
Rest	2.98	-16.9 (8)[+]	0.76	11.1 (8)	0.04	1.8 (8)	0.10	2.9 (8)	0.16	1.6 (8)
Exercise 0° incline										
0 - 2 hr	4.08[a]	-35.6[a] (11)	1.34[a]	21.0 (7)	0.10[a]	2.4 (11)	0.26[a]	11.3[a] (6)	0.19	2.9[a] (10)
2 - 4 hr	3.08	-39.6[a]	1.18	19.5	0.09[a]	3.1	0.28[a]	12.0[a]	0.16	3.0[a]
Exercise 9° incline										
0 - 1 hr	4.54[a]	-73.2[ab] (8)	4.29[ab]	26.3[a] (7)	0.18[ab]	1.9 (5)	0.61[ab]	18.7[a] (7)	0.23	6.3[a] (7)
1 - 2 hr	4.31[ab]	-66.7[ab] (8)	4.57[ab]	23.8[a]	0.18[ab]	2.6	0.70[ab]	23.6[ab]	0.21	4.1[a]
Standard Deviation	0.38	20.1	1.50	13.3	0.04	2.0	0.41	8.0	0.07	3.2

+ No. animals. Negative values indicate release

a - different from rest $p < 0.05$: b - exercise at 9° incline different from 0° incline $p < 0.05$.

Assuming an hepatic propionate uptake of 24 mmol/hr (for rest and exercise) and that alanine uptake represents 25% of the potential for amino acids to contribute to hepatic gluconeogensis, then the major gluconeogenic nutrients could supply 138%, 96% and 67% of the glucose output at rest or during exercise of moderate and high intensity respectively (assuming complete conversion). Therefore it is theoretically possible for hepatic gluconeogenesis to increase and meet the circulating glucose requirement of skeletal muscle during exercise of moderate but not of high intensity.

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