Comparative changes in glycogen concentrations after exercise in muscle, liver, kidney, skin and duodenum of sheep

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Little is known about the repletion of glycogen after exercise in tissues of ruminants other than muscle. Skeletal muscle is the major consumer of glucose in the body (1) and stores glycogen for its own use. Glycogen concentration of muscle is an important determinant of ultimate pH and eating quality of meat (2). However ruminants rely on gluconeogenesis in the liver and to a lesser extent the kidney to supply most of their glucose needs. Anaerobic exercise causes depletion of muscle and liver glycogen and has been used to model the effects of stress on muscle glycogen concentration (3). The aim of this experiment was to compare glycogen concentrations in a range of tissues before and after exercise and at a number of time intervals after exercise.

105 merino wethers that had a mean liveweight of 42.5 kg and had been shorn 3 months previously were used for the experiment. The exercise protocol consisted of running the sheep 4 times around a 2 kilometre track with a 15-minute rest interval between each run (Gardner *et al.*, 2001). Groups of sheep were slaughtered before and after exercise then at 12 hours, 24 hours and 48 hours after exercise. Each plot was replicated 3 times and contained 4 sheep for the pre and post exercise periods, and 3 sheep for the 12 hour, 24 hour and 48 hour post exercise periods. A pelleted diet was used for the experiment that contained lupin seed (25%), cereal hay (35%), barley grain (35%), bentonite (2%), sodium bicarbonate (0.7%), salt (0.5%), dicalcium phosphate (0.1%), vitamin mineral mixture (0.1%), and Bovatec50 ™ (0.02%). The pellets contained 12.2 MJ/kg metabolisable energy (ME) and 12.7% crude protein on a dry matter (DM) basis. Prior to exercise sheep were fed at the one rate of 1.62kg DM/sheep/day. There were 3 feeding treatments post exercise based on ME intake; fasting, maintenance (0.54 kg DM /sheep/day) and 3 times maintenance (1.62 kg DM/sheep/day). The results for glycogen concentration (g/100g) for the sheep fed 3 times maintenance post exercise are presented in the table below.

Exercise caused a significant reduction in glycogen concentration of liver and *m. longisimuss dorsi* (LD) but no change in the glycogen concentration of duodenum, skin or kidney. Time after exercise had a significant effect on glycogen concentration in all tissues. Glycogen concentration increased after exercise in liver before muscle when ME intake was 3 times maintenance. A transient accumulation of glycogen occurred in skin after exercise but the significance of this is unknown. Reductions in glycogen concentration after exercise in duodenum and kidney may have been secondary to changes in liver and muscle rather than direct effects of exercise.

Tissue	Pre-exercise	Time after exercise				
		0 hours	12 hours	24 hours	48 hours	Sig. (P)
Liver	2.85 ± 0.341^{ac}	1.18 ± 0.158^{b}	2.75 ± 0.160^{c}	2.25 ± 0.150^{d}	2.57 ± 0.142^{cd}	**
LD	2.16 ± 0.128^{a}	1.44 ± 0.118^{b}	1.28 ± 0.137^{b}	1.45 ± 0.134^{b}	1.67 ± 0.095^{b}	**
Duodenum	0.14 ± 0.016^{a}	0.12 ± 0.017^{a}	0.08 ± 0.004^{b}	0.08 ± 0.002^{b}	0.05 ± 0.016^{b}	**
Kidney	0.12 ± 0.009^{a}	0.1 ± 0.011^{a}	0.1 ± 0.005^{a}	0.09 ± 0.004^{b}	0.15 ± 0.017^{a}	**
Skin	0.06 ± 0.008^{a}	0.056 ± 0.002^{a}	0.41 ± 0.025^{b}	0.31 ± 0.029^{c}	0.05 ± 0.004^{a}	**

Values are means ± standard error of the mean (sem) ** $P < 0.01$.

References

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