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The effect of magnesium oxide on muscle glycogen metabolism during and after stress

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High levels of muscle glycogen before slaughter are synonymous with low levels of stress and premium quality meat. Magnesium supplementation has been shown to reduce the stress response in sheep suffering hypothermia (1). The stress response in pigs before slaughter was also reduced, leading to higher muscle glycogen concentrations (2). The aim of this experiment was to test the influence of supplemental magnesium oxide (MgO) on muscle glycogen concentration in sheep exposed to stress (exercise) and the commercial slaughter process.

Three groups of 18 one year old Merino wethers of 31.2 kg average starting liveweight, were fed (ad libitum) a diet containing 20% Hay, 48% barley, 20% lupin and 2% min-vits (ME 11.0 MJ/kg & Protein 16.3% in DM). The diet contained 0.17% Mg in DM. On day 15 of the experimental period the sheep were fed either 0%, 0.5% or 1% MgO for 10 days prior to the exercise treatment. Three days prior to exercise, a muscle biopsy was taken from the *m.semimembranosis* (SM) and *m.semitendinosis* (ST) and on day 25 the sheep were exercised for eight km in total at a trot (7 km/hr). Muscle biopsies were taken from the SM and ST immediately after exercise, 36 hrs and 72 hrs post-exercise. Animals had access to the base diet throughout the 72 hr post-exercise period. On day 45 of the experimental period the sheep were fed MgO (at the same rate received pre-exercise) for 10 days prior to slaughter at a commercial abattoir. A muscle biopsy was also taken from the SM and ST, one week prior to slaughter, and further samples of the SM and ST were taken approximately 30 minutes post-slaughter. Glycogen concentration was measured on muscle homogenates and calculated as the sum of glycogen plus lactate concentration.

Sheep supplemented with either 0.5% or 1% MgO lost between 12-24% less muscle glycogen in the ST during exercise. In the period up to 72 hrs post-exercise those animals supplemented with 1% MgO repleted about 55% more muscle glycogen in the SM than the 0% MgO group, with neither the 0.5% nor the 1% group having any significant difference from the control in the ST during this period. Making a comparison of "+/-" MgO, by grouping the two MgO treatments together, it was found that feeding MgO for four days pre-slaughter significantly increased the muscle glycogen concentration in the ST at slaughter by about 20%. We conclude that MgO appears to reduce the response to stress, leading to a subsequent reduction in glycogen loss, and increases the rate of glycogen repletion in skeletal muscle following stress.

	Muscle	Magnesium Treatment[y]			Significance of effect (P)[z]
		0%[x]	0.5%[x]	1.0%[x]	
ΔGlycogen conc. (g/100g)	SM	1.09 ± .080	1.05 ± .038	1.07 ± .045	ns
pre-post exercise	ST	0.94 ± .051[a]	0.72 ± .030[b]	0.82 ± .029[b]	**
ΔGlycogen conc. (g/100g)	SM	0.89 ± .078[a]	1.00 ± .112[a]	1.38 ± .142[b]	*
72 hr-post exercise	ST	0.69 ±.063[ab]	0.56 ± .087[a]	0.88 ± .089[b]	*

		0%[x]	0.5 and 1.0%[x]	
Glycogen conc. (g/100g)	SM	1.15 ± .066	1.24 ± .036	ns
post mortem	ST	0.71 ± .066	0.85 ± .037	*

[x] Mean ± sem. [y] Values with different superscripts are different. [z] ns - not significent; * - P<0.05; ** - P<0.01.

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2. D'Souza DN, Warner RD, Leury BJ, and Dunshea FR. The effect of dietary magnesium aspartate supplementation on pork quality. J Anim Sci 1998;76:104-9.