

The chronic effect of nitrogen intake on muscle glycogen metabolism at slaughter

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High muscle glycogen pre-slaughter is synonymous with low stress and premium quality meat. Hyperammonaemia increases catecholamines and reduces insulin, leading to hyperglycaemia and reduced peripheral glucose uptake (1). This experiment examines the effect of diets differing in rumen degradable nitrogen on muscle glycogen conc. in cattle following commercial slaughter.

Seventy 18 month old Angus heifers of starting liveweight 356 kg were allocated to one of 7 dietary treatment groups. There were 3 urea treatments, with the rations consisting of either 1%, 2%, or 3% urea mixed with 60-62% barley, 15% hay, 20% canola meal and 2% minerals. These rations had similar levels of metabolisable energy (ME 10.4 MJ/kg in DM) and crude protein (CP) ranged between 19.6% - 24.3% in DM. There were 4 lupin rations consisting of either 17%, 35%, 50% or 70% lupins, in all cases mixed with 15% hay, 0.75% - 0.5% urea and 2% minerals, with barley making up the remainder of each ration. The ME and CP ranged from 10.8 MJ/kg and 17.7% to 11.9 MJ/kg and 25.2% in DM for the 17% and 70% lupin rations. After 92 days on full feed, blood samples were taken for plasma ammonia and urea determination. Six days later the cattle were slaughtered commercially, after 15 hours lairage, and muscle samples taken from the *m.semimembranosis* (SM) and *m.semitendinosis* (ST) for glycogen determination.

	Diet							Signif. of effect (P)
	1% Urea	2% Urea	3% Urea	17% Lupin	35% Lupin	50% Lupin	70% Lupin	
Glycogen concentration (g/100g)								
SM	1.70 ± .100 ^a	1.58 ± .057 ^{abc}	1.46 ± .076 ^{bc}	1.59 ± .048 ^{ab}	1.50 ± .046 ^{abc}	1.66 ± .089 ^{ab}	1.69 ± .105 ^a	*
ST	1.40 ± .085 ^a	1.17 ± .064 ^{bc}	1.13 ± .075 ^{bc}	1.24 ± .044 ^{ab}	1.10 ± .048 ^{bc}	1.25 ± .082 ^{abc}	1.38 ± .065 ^a	**
Plasma metabolite concentration (mmol/L)								
Urea	8.5 ± .40 ^a	10.0 ± .01 ^b	12.6 ± .57 ^{cd}	8.22 ± .46 ^a	10.9 ± .37 ^{bc}	11.8 ± .74 ^{cd}	14.0 ± .70 ^c	**
Ammonia	0.57 ± .014 ^a	0.55 ± .010 ^a	0.66 ± .018 ^b	0.57 ± .019 ^a	0.58 ± .012 ^a	0.59 ± .020 ^a	0.59 ± .012 ^a	*

Mean ± sem. Glycogen = total glucose + lactate. Values within rows followed by the same superscript are not different. * $P < 0.05$; ** $P < 0.01$.

Plasma urea demonstrated a positive linear relationship with increasing urea ($P < 0.01$) and lupin ($P < 0.01$) inclusion in the diet. Plasma ammonia did not differ, except for animals on the 3% urea diet ($P < 0.05$) which had levels 14% higher than other diets. In the SM and ST there was a negative linear relationship between increasing dietary urea inclusion and glycogen concentration ($P < 0.05$), with animals on the 1% urea diet having 16% and 24% more glycogen in the SM and ST than animals on the 3% urea diet. Glycogen for the lupin treatment groups did not differ. We conclude that diets high in urea may reduce glycogen concentrations at slaughter, although lupins do not have this effect. This may be related to the rate of absorption of ammonia from the rumen.

1. Fernandez, J.M., Croom, W.J., Johnson, A.D., Jaquette, R.D., Edens, F.W. Subclinical ammonia toxicity in steers: effects on regulatory hormone concentrations. J. Anim. Sci. 1988; 66:3259-66