Feeding corn and barley based concentrates to grazing dairy cows. I. Responses to insulin and β-adrenergic stimuli

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A high protein (CP) non structural carbohydrate (NSCH) ratio in autumn-winter forages lead to high rumen ammonia (N-NH$_3$) levels (16-60 mg/dl). Feeding concentrates with different ruminal starch degradability may be a way to synchronize protein/energy availabilities reducing the risk of N-NH$_3$ excess. Hyperammonemia may induce insulin resistance and enhanced β-adrenergic responses (Fernández *et al*, 1988, J Anim Sci, 66, 3259-3266 ; Visek, 1984, J Dairy Sci, 67, 481-498 ; Symonds *et al*, 1981, Br J Nutr, 46,481-486).

Twenty seven Holstein cows (85 ± 17 days postpartum) grazing an oat sward (CP = 23.9 %, NSCH = 16.9 %) and a pasture of ryegrass (CP = 15.9 %, NSCH = 19.5 %) in winter were assigned to three treatments : PA : only forage, CO : forage plus 7 kg/cow/d of a corn (75 %) based concentrate and BA : forage plus 7 kg/cow/d of a barley (85 %) based concentrate. Preprandial jugular blood samples were taken (5 wks) to evaluate metabolite concentrations. Samples were taken before (INS-0), 30 (INS-30), 60 (INS-60) and 90 (INS-90) minutes after an intravenous bovine insulin challenge (0.12 units/kg body weight) (wk 2) and before (ISO-0) and 15 minutes after (ISO-15) isoproterenol challenge (4 nmol/kg body weight) (wk 3). Urea, triglycerides (TG), glucose and free fatty acids (FFA) were determined using enzymatic kits. Data were analysed using an split-plot design with treatment as main plot and week or sampling time as secondary plot.

Intake of concentrates was 6.3 and 5.3 kg/cow/d in CO and BA. Forage dry matter intake was higher in PA respect to CO and BA (11.93 vs 11.02 and 10.75 kg DM/cow/d, P<0.05). Milk yield was higher in CO (21.5 kg/cow/d) respect to PA (17.0) (P<0.05) but similar between BA (18.4 kg/cow/d) and the other treatments. Milk fat was lower in BA (2.84 %) respect to MA (3.01 %) and PA (3.45 %). Rumen N-NH3 (six additional fistulated cows) was 15.7, 14.1 and 15.7 mg/dl in PA, CO and BA (P<0.15) (range 5 to 26 mg/dl). Plasma urea was higher in PA (24.2 mg %) respect to BA (21.2 mg %) (P<0.05) and similar between CO (22.3 mg %) and the other treatments. Plasma urea correlated with milk yield (-0.204, P<0.05) and FFA (0.28, P<0.01). Glucose, TG and FFA were similar across treatments. Glucose and FFA concentrations for ISO-0 were 74.7, 71.8 and 70.0 mg/dl and 558, 412 and 364 µeq/l in PA, CO and BA respectively (P>0.05). ISO-15 values were 84.3, 81.3, 80.0 mg/dl for glucose and 906, 722, 770 µeq/l for FFA in PA, CO and BA respectively (P>0.05). Changes in plasma glucose and FFA concentrations after INS challenge did not differ.

Higher β-adrenergic responses or resistance to insulin action were not observed in cows grazing pastures rich in CP in winter but in the experiment, the forage NSCH content was high and N-NH3 and plasma urea were relatively low.

	PA	CO	BA	Mean
Glucose (mg/dl)				
INS-0	78.2	75.6	77.1	76.9[a]
INS-30	40.1	34.0	40.27	38.1[b]
INS-60	50.1	48.7	51.5	50.1[c]
INS-90	65.1	60.5	64.4	63.3[d]
FFA (µeq/l)				
INS-0	338	309	401	349[a]
INS-30	271	246	271	262[b]
INS-60	381	328	334	348[a]
INS-90	490	359	393	414[c]

[a,b,c,d] : means with different letters differ (P<0.05). Neither treatment nor interaction effects were detected