Long Term Impact of the Plane of Nutrition on Milk Protein Production

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The plane of nutrition (PON) influences the production potential of the dairy cow. One of the major limitations in grazing systems is the climatic effect where pasture productivity varies considerably throughout the year (Smit *et al* 2005) resulting in restricted feed intake often compromising milk protein synthesis (Walker *et al* 2004). The objectives of this study were to determine whether a short (3 weeks) and long term (9 weeks) reduction in the PON affects milk yield and protein production and if the length of nutritional restriction impairs the capacity of the udder to respond to a subsequent increase in PON.

Thirty-six Holstein Friesian cows in mid-lactation (87 ± 13 days in milk on day one) were fed a diet comprising of ryegrass pasture (~7kg DM/day), canola meal/mineral mix (1.3kg DM/day), barley/sorghum grain mix (2.7 kg DM/day) and equal amounts of maize and forage sorghum silage (~5kg DM/day). The 20-week experiment included three treatments; 1) a high PON (C), 2) a low PON for 9 weeks (L9) and; 3) a low PON for 3 weeks (L3). Four periods were applied including a covariate period: high PON for all treatments (week 1-5); period 2A: low PON for the L9 cows (week 6-11); period 2B: low PON for the L9 and L3 cows (week 12-14) and period 3: high PON for all treatments (week 15-20). The low PON treatments were imposed by removing the silage from the diet to elicit a 4-5 litre reduction in milk yield/day. Pasture dry matter intake was measured and allocated using a calibrated rising plate meter. All other feeds were fed out individually. Milk yield was recorded twice daily with individual milk samples collected twice weekly and analysed for milk protein, fat, and lactose concentration. Liveweights were recorded daily and body condition score (BCS) was assessed weekly.

There was no significant difference in milk yield during period 2A for the L9 cows. A more severe feed restriction imposed during period 2B caused a more rapid decline in milk yield for the L3 cows. There was no significant difference in milk protein, fat and lactose concentration between all treatment groups and across all periods. In comparison to the covariate period, milk protein yield during period 2B was 34% lower for the L9 cows and 30% lower for the L3 cows. There was no significant difference in milk protein yield during the recovery period. There was no change in BCS or liveweight between treatments throughout the experiment.

Table 1. Means and standard errors of difference of milk yield and milk protein concentration and yield for cows on a high plane of nutrition (C), low plane of nutrition for a 3 week period (L3) and low plane of nutrition for a 9 week period (L9) throughout the experimental period

	Period	*Treatment Group*			*P-value*	SED[1]
		C	L3	L9		
Milk Yield (litres/day)	2A	25.4	24.7	22.5	0.132	1.42
	2B	22.9[a]	18.6[b]	18.0[b]	<0.001	1.03
	3	21.4	19.7	18.9	0.100	1.15
Milk Protein (%, m/v)	2A	3.11	3.15	3.04	0.467	0.104
	2B	3.07	3.06	3.03	0.929	0.105
	3	3.17	3.08	3.09	0.636	0.091
Milk Protein Yield (g/day)	2A	786[ab]	812[a]	700[b]	0.021	45.3
	2B	699[a]	569[b]	561[b]	<0.001	22.3
	3	688	625	607	0.057	31.6

[1]SED = Standard error of difference; [a,b] = Values representing significance at P=0.05

A short and long term reduction in the PON has no effect on milk protein concentration, but did reduce milk protein yield, which mimicked milk yield. Milk yield increased in the recovery period, which indicates that a short (3 weeks) or long (9 weeks) term decline in the PON has no residual effect on the capacity of the mammary gland to produce milk. However, with no decline in BCS and liveweight, pasture intake may have been higher than measured. In conclusion, feed restriction after peak milk yield does have an immediate effect on milk yield and milk protein yield, but does not have a carry over effect on milk production when a high plane of nutrition is restored. The implication for industry is that there appears to be no long term effect on the ability of the cow to respond to improved nutrition following periods of feed restriction.

Smit, H.J., Tas, B.B., Taweel, H.Z., Tamminga, S. and Elgersma, A. (2005). *Grass and Forage Science*. **60**: 297
Walker, G.P., Dunshea, F.R. and Doyle, P.T. (2004). *Australian Journal of Agricultural Research*. **55**: 1009

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