

The effect of dietary proportions of kale (*brassica oleracea*) and grass silage on rumen pH and volatile fatty acid concentrations in dry dairy cows

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Introduction Ruminant pH is a critical factor in the normal and stable function of the rumen. A reduction in ruminal pH below normal (< 5.6) can have significant impact on microbial activity, rumen function, and animal productivity and health (Nagaraja and Titgemeyer, 2007). Forage brassicas are an alternative forage source offered to dairy cows for *in-situ* grazing. However, there is a scarcity of literature examining the effect of feeding diets composed of high proportions of kale (*brassica oleracea*) or kale alone on rumen pH and VFA production in the rumen.

Materials and methods In 2006/2007, an experiment was conducted at Moorepark Dairy Production Research Centre, Co. Cork, Ireland, evaluating the effect of offering differing proportions of kale and perennial ryegrass (*Lolium perenne*) silage on rumen physiology. Four multiparous pregnant dry dairy (100 ± 12 days pre-partum; 600 ± 15 kg of liveweight (LW)) cows permanently fitted with ruminal cannulae were randomly assigned to four kale: grass silage dietary proportions (0:100, K0; 60:40, K60; 85:15, K85 and 100:0, K100) on a dry matter (DM) basis in a 4x4 Latin Square design with four 20 day periods. Cows were acclimatised for fifteen days, followed by a five day period of experimental sampling and measurement. Internal pH meters were installed to continuously monitor rumen pH while rumen liquor collection tubes were used to sample rumen liquor for volatile fatty acid analysis at 0, 4, 8 and 12 h after feeding on each sampling day. Cows were offered a total of 10 kg DM of forage daily at 08.00 h. Average intake and ruminal pH variables from each cow over five days of each period and from four times within each day were recorded. Analysis with mixed model procedures of SAS (SAS Institute, 2008) was used to model the correlation structure of the repeated measurements. Treatment, block effect, day and time of day were included in the model for the data as necessary structural terms and interactions were examined. An unstructured covariance model was used for the time of day (unequal spacing) and compound symmetry for the day. There was no evidence found to support more complex covariances for the effect of day.

Results The chemical and mineral composition of the kale and grass silage offered in this study are presented in Keogh *et al.* (2009). Cows on treatment K85 had a lower ($P < 0.001$) ruminal pH compared to cows on treatments K100, K60 or K0 (Table 1). While a gradual decrease in rumen pH was observed over an eight hour period for K85 before recovery, offering K100 did not reduce rumen pH below 6.0 or induce acidosis (Figure 1). Increasing the dietary proportion of kale did not affect ($P > 0.05$) acetate: propionate ratio production between treatments (Table 1). Cows offered K60 had increased ($P < 0.05$) rumen VFA concentration relative to K0 while offering K85 and K100 had no effect on rumen VFA concentration (Table 1). Offering dry cows K100 relative to K0 reduced dry matter intake by 17.5% (7.32 vs. 8.87 kg DM day⁻¹, respectively) which may be associated with the presence S-methyl-L-cysteine sulphoxide (Barry and Manley, 1985) which can cause haemolytic anaemia and depressed DM intake.

Table 1 Effect of four pre-calving dietary proportions of kale: grass silage on dry matter intake (DMI kg⁻¹ day), Acetic: Propionic ratio (AC:PR; mmol L⁻¹) and total volatile fatty acid (VFA) concentration (mmol L⁻¹).

	K100	K85	K60	K0	s.e.	P
Kale DMI	-	6.35	4.90	-		
Grass silage DMI	-	1.71	3.28	-		
Total DMI	7.32 ^b	8.06 ^{ab}	8.18 ^{ab}	8.87 ^a	0.531	0.05
AC: PR	3.78	3.86	3.65	3.71	0.195	n.s.
Total VFA	59.35 ^{ab}	61.74 ^{ab}	71.67 ^a	53.45 ^b	4.887	0.05
Mean rumen pH	6.26 ^a	5.91 ^b	6.32 ^a	6.32 ^a	0.05	0.001

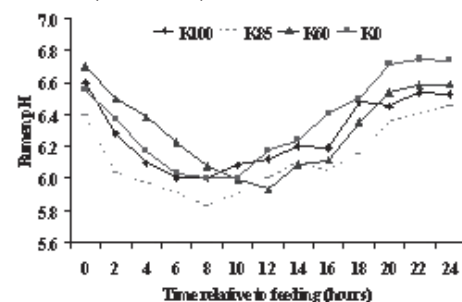


Figure 1 The diurnal pattern of rumen pH in dry dairy cows offered on a DM basis four kale: grass silage dietary proportions; 100:0, K100 (●—●), 85:15, K85 (—▲—), 60:40, K60 (▲—▲) and 0:100, K0 (■—■). Feeding time was at 0800 h.

Conclusions The results suggest that increasing the dietary proportion of kale was associated with a progressive decrease in dry matter intake but with minimal effects on rumen pH and total volatile fatty acid concentration. The progressive decrease in dry matter intake may warrant further research on a larger scale, over a longer period of time while offered *in-situ* to elucidate potential effects on dry dairy cow performance.

References

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