An evaluation of the effects of silage digestibility on the performance of, and concentrate sparing effect of, finishing beef cattle, lactating dairy cows, pregnant ewes and finishing lambs

T.W.J. Keady and J.P. Hanrahan

Teagasc, Animal & Grassland Research & Innovation Centre, Athenry, Co. Galway, Ireland. Email: tim.keady@teagasc.ie

Introduction Digestibility is the most important factor influencing the feed value of grass silage (Keady et al., 2000). Grass silage forms the basal forage for finishing beef cattle, lactating dairy cows, pregnant ewes and finishing lambs during the indoor feeding period in many regions world wide. The aims of this study were to determine the effects of silage digestibility on the performance of, and the concentrate requirements of, finishing beef cattle, lactating dairy cows, finishing lambs and pregnant ewes.

Materials and methods Data from 76 comparisons (34, 23, 10 and 9 comparisons involving finishing beef cattle, lactating dairy cows, finishing lambs and pregnant ewes respectively) in which grass silages differing in digestibility were offered as the sole forage, supplemented with differing levels of concentrate were used in the current study. Where not available, the digestible organic matter digestibility (D-value) of the grass silages was determined from dry matter digestibility using the equations of Keady et al (2001). Silage composition, silage and concentrate intakes, and animal performance data from the 79 comparisons are presented by Keady et al (2013). The data was categorised according to the source and least squares procedures were used to fit a model with source as a fixed effect and the proportion of the forage in the diet as a covariate; the linearity of the effect of forage proportion was tested in all cases by fitting a quadratic term but this was not significant in any case.

Results and Discussion The effects of silage D-value on food intake and animal performance are presented in Table 1. The mean response to an increase of 10 g/kg in D-value was 0.33 kg/day, 23.8 g/day and 9.3 g/day of milk yield of dairy cows, carcass gain of beef cattle and carcass gain of finishing lambs, respectively. The response to silage D-value varied significantly with forage:concentrate ratio of the diet. Whilst the response to silage D-value declines as concentrate feed level increased, it was still significant when concentrate accounted for 60% of total DM intake. In studies involving pregnant ewes, the silages were offered *ad libitum* for up to 14 weeks of mid and late pregnancy. The mean response to each 10 g/kg increase in silage D-value was an increase in ewe weight post lambing of 1.3 ± 0.08 kg and an extra 52.3 ± 11.41 g in lamb birth weight. When the 9 comparisons involving pregnant ewes were analysed for the effect of concentrate input (mean of 16.6 kg DM) in late pregnancy (as a proxy for the proportion of forage in the diet) there was no evidence of any association. The regression equations describing the effects of silage digestibility and concentrate feed level on animal performance are presented in Table 2. There was no interaction ($P>0.05$) between silage D-value and concentrate feed level, or for any quadratic effects, for the response of the performance of lactating dairy cows, finishing lambs or pregnant ewes. Each increase of 5 units in silage D-value enables the yields of milk and of fat + protein from dairy cows, carcass gain by finishing lambs and lamb birth weight to be maintained whilst concentrate DM feed level was reduced by 2.35 kg/d, 2.80 kg/d 0.30 kg/d and 19.2 kg during late pregnancy, respectively. For finishing beef cattle there was a significant interaction between silage D-value and concentrate feed level; as silage D-value increased the effect of increased concentrate feed level on concentrate sparing affect declined (Table 3).

Conclusions Each 10 g/kg increase in D-value increases carcass gain of finishing beef cattle and lambs, and milk yield of dairy cows by 23.8 g/d, 9.3 g/d and 0.33 kg/d, respectively. Whilst the response to silage digestibility declines as the proportion of the concentrate in the diet increases, the response to silage digestibility is still significant when concentrate accounts for 60% of feed DM intake. Assuming that silage D-value declines by 33 g/kg per week delay in harvest (Keady et al 2013) on extra 1.55 kg/d, 0.20 kg/d and 12.7 kg (in late pregnancy) of concentrate DM is required to maintain milk yield of dairy cows, carcass gain of lambs and lamb birth weight for each 1 week delay in harvest. For beef cattle offered 670 or 710g/kg, D-value silage supplement with 4 kg concentrate, each week delay in harvest requires an additional 1.5 and 1.97 kg/d concentrate DM to maintain carcass gain.

Table 1 Responses in animal performance to a change of 10 g/kg in silage D-value

Animal type	Performance trait	Forage: concentrate ratio			
		100:0	80:20	60:40	40:60
Lactating dairy cows	Milk yield (kg/day)	-	0.58 ± 0.144	0.37 ± 0.050	0.16 ± 0.100
	Fat (g/kg)	-	-0.01±0.220	-0.07 ± 0.076	-0.13 ± 0.152
	Protein (g/kg)	-	0.14 ± 0.093	0.06 ± 0.032	0.26 ± 0.065
	Fat +Protein yield (kg)	-	0.037±0.0101	0.026±0.0035	0.015±0.0070
	DM intake (kg/day)	-	0.33 ± 0.277	0.20‡ ± 0.096	0.07 ± 0.192
Finishing beef cattle	Carcass gain (kg/day)	35 ± 4.0	26 ± 2.5	17 ± 2.9	8 ± 4.8
	DM intake (kg/day)	0.12 ± 0.010	0.09 ± 0.006	0.07 ± 0.014	0.04 ± 0.024
Finishing lambs	Carcass gain (g/day)	16 ± 2.3	13 ± 1.3	9 ± 0.9	6 ± 1.5
	DM intake (kg/day)	0.08 ± 0.007	0.07 ± 0.004	0.05 ± 0.003	0.03 ± 0.005

Responses in bold are significantly different from zero ($P<0.05$), ‡ $P=0.057$

Table 2 Relationships between animal performance, silage D-value and concentrate level

Animal type‡	**Performance trait**	**Constant**	**D-value**†	**Conc**§	**D-value *Conc**	**Conc^2**	**R^2**	**Sig**¶
DC	Milk yield (kg/d)	4.85	+0.260 (0.0462)	+0.554 (0.1265)			0.61	***
	Fat & Protein (kg/d)	-0.034	+0.023 (0.0036)	+0.041 (0.0098)			0.64	***
BC	Carcass gain (kg/d)	-1.90	+0.033 (0.0037)	+0.333 (0.0661)	-0.0036 (0.00100)	-0.0038 (0.00199)	0.75	***
FL	Carcass gain (g/d)	-632	+8.6 (1.21)	+142.4 (13.60)			0.91	***
PE	Lamb BW (kg)	0.73	+0.050 (0.0115)	+0.013 (0.0120)			0.67	***

‡DC = dairy cows; BC = beef cattle; FL = finishing lambs; PE = pregnant ewes.
†In units of 10 g/kg; §Concentrate dry matter (kg/d); ¶Significance of the regression equation

Table 3 Effect of an increase in silage D-value (+50 g/kg) on concentrate sparing effect of beef cattle offered silages differing in D-value and supplemented with different levels of concentrate

	Concentrate DM (kg/d)		
D-value (DMD)	2	4	6
670 (711)	1.67	1.50	1.21
690 (731)	1.85	1.70	1.44
710 (751)	2.07	1.97	1.77
730 (771)	2.35	2.34	2.32

References

Keady, T.W.J., Hanrahan, J.P., Marley C.L., and Scollan, N.D.2013. Production and utilization of ensiled forages by beef cattle, dairy cows, pregnant ewes and finishing lambs – A review. Agri. and Fd. Sci. 22:70-92.

Keady, T.W.J., Mayne, C.S. and Fitzpatrick, D.A. 2000. Prediction of silage feeding value from the analysis of the herbage at ensiling and effects of nitrogen fertilizer, date of harvest and additive treatment in grass silage composition. Jr. Agr. Sci., Camb., 134: 353-368

Keady, T.W.J., Mayne, C.S. and Kilpatrick, D.J., 2001. Prediction of silage dry matter digestibility from digestible organic matter digestibility. Proc. of BSAS, p 93.