The effect of offering grass silage alone or in combination with legume: cereal wholecrop silage on methane emissions of Holstein steers

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Introduction The UK target under the Kyoto Agreement is to reduce greenhouse gas emissions (GHG) by 80% by 2050. With specific reference to agriculture, the UK Climate Change Committee indicate an 8.5% reduction in GHG emissions from agriculture by 2020. The main GHG's that are of concern in agriculture are methane (CH_4) from enteric fermentation and manure storage and N_2O from agricultural soils and fertiliser use. Diet has been shown to effect methane emissions. Waghorn (2002) demonstrated that ram lambs offered the legume crop lotus had almost a 55% decrease in methane emissions relative to ram lambs offered ryegrass/white clover (Waghorn, 2002). Increasing the proportion of concentrates in the diet have also be observed to decrease methane production per kg dry matter intake (DMI) relative to forage-based diets due to the intake and higher starch levels in the concentrate proportion favouring propionate production (McAllister *et al*, 2000). However, there are no known research data available on the methane emissions from finishing beef cattle offered legume/cereal wholecrop silages. On this basis the objective of the current study is to measure methane emissions of Holstein steers offered legume/cereal wholecrop silages.

Material and methods Fifteen Holstein steers (491 $\pm$ 24.1 kg) were allocated to one of 5 forage treatments in a partially balanced change-over design. The five forage diets offered included perennial ryegrass-based grass silage (PGS), fescue/perennial ryegrass-based grass silage (FGS) and lupins/triticale, lupins/wheat and peas/oat wholecrop silages offered in combination with PGS at a ratio of 50:50 legume/cereal wholecrop: PGS on a dry matter (DM) basis. The forages were offered *ad libitum* and supplemented with 4 kg concentrates/head/day. The Holstein steers were housed in slatted accommodation and offered experimental diets for a minimum of 20 days. Three Holstein steers per treatment were then transferred to individual metabolism crates for 8 days to become acclimatised to being restrained individually. The animals were then transferred to indirect respiration calorimeter chambers for 3 days where methane (CH_4) emissions were measured during the final 2 days. The process was then repeated with animals allocated to different diets. Data from the current study was used to calculate methane emissions from a parallel study (Kennedy and Dawson 2009) where continental finishing beef steers were offered the same forage diets as the current study. Results were analysed using one way ANOVA with start weight and animal tag number used as covariates.

Results
Forage had no significant effect on forage DMI, total DMI, CH_4, CH_4/DMI and CH_4/live weight (LWT) (Table 1). The results presented in Table 1 demonstrate forage treatment had no significant effect on methane emissions expressed as carbon dioxide equivalents (CO_2e) per head or per kg carcass gain.

Table 1 Effect of forage type on methane emissions from Holstein steers.

	Forage						
	PGS	FGS	Lupins/ triticale‡	Lupins/ wheat‡	Pea/ Oats‡	sed	Sig.
Forage DMI (kg/day)	5.4	6.3	6.1	6.5	6.2	1.08	NS
Total DMI (kg/day)	8.4	9.3	9.1	9.5	6.1	1.08	NS
CH_4 (litres/day)	358	342	312	338	369	30.3	NS
CH_4/DMI (litres/kg)	43.1	37.2	34.8	35.1	40.4	3.74	NS
CH_4/LWT (litres/day per kg)	0.71	0.68	0.62	0.67	0.73	0.061	NS
Data from Kennedy and Dawson (2009)							
CO_2e (kg/head)	922	706	746	748	815	52.8	NS
CO_2e/carcass gain (kg/kg)†	12.7	9.3	14.0	12.8	13.7	2.97	NS

‡: Legume/cereal wholecrop offered on 50:50 DM ratio with PGS; PGS: Perennial ryegrass-based grass silage.
FGS: Fescue/perennial ryegrass-based grass silage. DMI: Dry matter Intake. LWT: Live weight
CO_2e : Carbon dioxide equivalents (((CH4 Litres / 22.4)*16)*25)

Conclusion Offering Holstein steers legume/cereal wholecrop silage had no beneficial effect on intake or methane emissions relative to offering grass silage based diets. However, these conclusions need to be considered enlight of the major variability within the data which affects the ability to detect significant differences.

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