Short-term measurements to estimate methane emissions by beef cattle using the GreenFeed monitoring unit

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Methane emission from ruminants constitutes 10% of anthropogenic greenhouse gas emission in pastoral countries such as Uruguay and Australia. Emission inventories and mitigation claims require accurate estimation of methane emission from ruminants in their production environment. The GreenFeed unit estimates the metabolic gas output of cattle (CH_4 and CO_2) from short-term measurements of exhaled or eructated gases. Pellets are used to lure individual cattle to a feeding station where the composition and flux rates of gases released by them are determined. Pellet delivery is programed to promote an even distribution of visits to the feeding station during the day. The aim of this experiment was to compare estimates of daily methane emissions obtained using the GreenFeed unit with those obtained using the prediction method suggested by the Intergovernmental Panel on Climate Change (IPCC).

Ten Angus steers (365.2 ± 50 kg liveweight) were housed in a pen in an open barn and were given daily access to an outside pen. The steers were adapted to the diet, GreenFeed unit and facilities for 3 weeks before the experiment started. The basal diet (lucerne hay and cereal chaff; 13% crude protein, 9.3 MJ ME per kg DM) was delivered ad libitum using an auto feeder fitted with a radio-frequency identification system for recording individual meal consumption. Emissions and pellet delivery were measured using the GreenFeed unit. Pellet delivery (6 mm diameter pellets; 13.4% crude protein, 9.5 MJ ME per kg DM) was programed to allow each animal access to six releases of pellets of 30 g each per feeding session (45 s between releases and a minimum delay of 4 h between feeding sessions). Six consecutive three-day periods were used to estimate emissions and intakes.

The predicted emission of CH_4 was calculated using dry matter intake (DMI) and feed energy content using the theoretical emission factor suggested by the IPCC: (CH_4 = gross energy intake × 0.065). Boadi et al. (2002) reported similar relationships using a tracer technique (SF_6) and calorimetry (CH_4 = gross energy intake × 0.067 and CH_4 = gross energy intake × 0.063, respectively). Estimates of individual CH_4 emissions derived using the GreenFeed unit are expressed as the average of all short-term measurements within the period (mean = five visits per d of 5 min each) (Table 1). Repeatability of CH_4 estimates and dry matter intake were estimated using the equation of Fowler and Cohen (see Harper, 1994).

Similar daily CH_4 emissions were reported by McCaughey et al. (1997) for grazing crossbred steers of liveweight similar to that of the animals used in our trial. Between-period variation in individual CH_4 emission was not significant (P = 0.29). The correlation (r) between individual measured and predicted methane

Table 1. Dry matter intake (DMI) and CH_4 emission of cattle estimated from data obtained from six consecutive three-day periods using the GreenFeed unit and predicted emission of CH_4 calculated according to the IPCC method.

	Mean	SD	Minimum	Maximum	Repeatability
DMI (kg/d)	8.82	2.36	2.17	13.59	0.10
CH_4** (g/d)	216.91	39.06	147.56	290.15	0.37
Predicted* CH_4 (g/d)	184.08	50.37	41.93	285.59	
CH_4/DMI** (g/kg)	24.6	9.14			

*Calculated as 6.5% of gross energy intake. **Means for all visits to the GreenFeed unit.

emissions was 0.82.

It is concluded that short-term measurements made using the GreenFeed unit can be used to estimate CH_4 emissions in an animal's production environment. This creates opportunities for ranking individual animals and for testing diets under grazing conditions. Validation of the GreenFeed unit using calorimetry is warranted.

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McCaughey WP, Wittenberg K, Corrigan D (1997) Methane production by steers on pasture. Canadian Journal of Animal Science 77, 519–524.