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Quantifying variation in estimated methane emission from ruminants using the
SF₆ tracer technique

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Abstract

With the signing of the Kyoto Protocol, New Zealand must reduce its national greenhouse gas emissions. As New Zealand has a large proportion of its national emissions as methane (~31%), and methane (CH₄) has a short atmospheric lifetime, it provides a good target for mitigation strategies.

The initial aim of this research was to identify high and low CH₄-emitting cattle to assess factors that contribute to low CH₄ production. Initial studies using the SF₆ tracer technique to estimate CH₄ production could not identify consistently high and low CH₄ emitters. Research was therefore undertaken to confirm whether this was due to high variation in estimated CH₄ yields, and to quantify the within- and between-animal variation in CH₄ production when using the SF₆ technique.

This research showed considerable within- (coefficient of variation, CV = 7-10%) and between-animal (CV = 7-18%) variation in CH₄ yield (g CH₄/kg DMI) over time when using the SF₆ technique. This is larger than the within- (CV = 3%) and between-animal (CV = 10%) variation reported for calorimetry. This led to the recommendation that the SF₆ technique not be used in identifying animals for high or low CH₄ yield. A power analysis was developed based on the measured variances for the SF₆ technique. Results from this analysis provide researchers with important information on the number of animals and measurements per animal required when undertaking CH₄ experiments.

One of the sources of variation with the SF₆ technique is the SF₆ release from permeation tubes. Estimated CH₄ yield increases by approximately 8.5% when going from a release rate of 3 mg SF₆/day to a rate of 5 mg SF₆/day. Further, an *in vitro* study indicated that SF₆ release from permeation tubes is approximately 8% lower in rumen fluid than in air. While further research is required to confirm these results, they emphasise the need to allow time for the release rate to stabilise in the rumen for 4-5 days prior to undertaking measurements. It also led to the recommendation that release rates used in experiments should be within a narrow range, and balanced across experimental treatments.

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