Quantifying variation in estimated methane emission from ruminants using the SF_6 tracer technique

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

In

Animal Science

At Massey University, Palmerston North, New Zealand.

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2008

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 (CH_4) 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 CH_4-emitting cattle to assess factors that contribute to low CH_4 production. Initial studies using the SF_6 tracer technique to estimate CH_4 production could not identify consistently high and low CH_4 emitters. Research was therefore undertaken to confirm whether this was due to high variation in estimated CH_4 yields, and to quantify the within- and between-animal variation in CH_4 production when using the SF_6 technique.

This research showed considerable within- (coefficient of variation, CV = 7-10%) and between-animal (CV = 7-18%) variation in CH_4 yield (g CH_4/kg DMI) over time when using the SF_6 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 SF_6 technique not be used in identifying animals for high or low CH_4 yield. A power analysis was developed based on the measured variances for the SF_6 technique. Results from this analysis provide researchers with important information on the number of animals and measurements per animal required when undertaking CH_4 experiments.

One of the sources of variation with the SF_6 technique is the SF_6 release from permeation tubes. Estimated CH_4 yield increases by approximately 8.5% when going from a release rate of 3 mg SF_6/day to a rate of 5 mg SF_6/day. Further, an *in vitro* study indicated that SF_6 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.

Acknowledgements

Many thanks to my supervisors, Drs. Ian Brookes, Simone Hoskin and Harry Clark for their time, input and advice on both the experimental planning and writing up of this thesis – without them it would not have been possible.

Particular gratitude to Harry Clark for advice on planning and carrying out the research, for the big picture focus of how things fit together, and teaching me about scientific writing.

Thanks also to Dr. Garry Waghorn and Dr. Keith Lassey for their advice and input into my research and for their openness in discussing the results of my research.

To the methane group, particularly German Molano and Adrienne Smith, for putting up with and accommodating me during the experimental work. Your helpfulness with the animal experiments at Grasslands has been much appreciated.

Thanks to Dr. Mike Tavendale for his ideas and expertise in developing the method to measure SF_6 in faecal gas and designing the system to measure SF_6 gas release from permeation tubes.

To all those at Ellinbank, particularly Dr. Chris Grainger, Tim Clark and Di Mapleson, who not only helped with experimental work, but whose friendship was much appreciated during my stay there.

I would also like to acknowledge the input of Drs John Koolaard and Nicolas Lopez-Villalobos and Mr. Fred Potter for help with statistical analyses and the time they spent helping me improve my understanding of statistics and their meaning.

My thanks to the Pastoral Greenhouse Gas Research Consortium for providing the funding for my stipend and the experimental work.

Special thanks to my wife, Ruth, for her support and encouragement while undertaking these studies.

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