Development of methane–releasing permeation devices for intraruminal use

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For the past decade, methane production rate of grazing ruminants has been estimated by a tracer based technique in which the tracer (sulphur hexafluoride; SF_6) is released by a permeation device in the rumen and the ratio of methane and SF_6 in expired gas is determined (Johnston *et al.* 1994). While the method has been extensively used, the physical attributes of SF_6 gas (density and solubility) differ from those of methane so SF_6 is not an ideal tracer for enteric methane studies. These differences, together with SF_6 being a potent greenhouse gas, indicate that use of an isotopic form of methane in place of SF_6 would be advantageous for field studies. ^{14}C and ^{3}H labelled methane has been used for studies in housed animals (Murray *et al.* 1976) and stable isotopes (^{13}C, ^{2}H) could potentially be used in the field.

Methane has a low boiling point and a high vapour pressure, relative to SF_6, so the constant release of SF_6 from permeation devices cannot be presumed to occur for methane. Two brass permeation tubes (internal volume 2.7 ml) with Teflon™ permeation membranes (125 µm, 7 mm diameter) at each end were constructed. With the lower membrane installed, each tube was cooled in liquid nitrogen and approximately 1500 ml of methane gas injected over a period of 4 minutes. Methane that liquefied in the tubes was then trapped by fitting and tightening the upper membrane. Both membranes were repeatedly tightened on removal from liquid nitrogen.Tubes were incubated at 39°C and change in weight of the tubes was measured for 24 days (Figure 1).

The daily release rate of methane was not constant as had been found for SF_6 permeation tubes (Lassey *et al.* 2001), but declined at 2.3% to 2.6% of the initial rate of methane release each day. The rate of decline was strongly linear (r^2 = 0.9 – 0.94) which suggests that the release rate while the permeation tube was in the rumen could be adequately predicted from a preliminary (gravimetric) calibration period, with the standard error of the regression coefficient being less than 3% of the mean slope.

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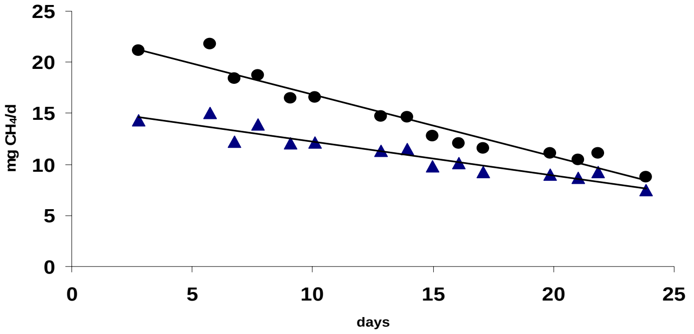

Figure 1 Release (mg/d) of methane from brass permeation tubes (tube 1 ●; tube 2 ▲) containing approximately 1500 ml of methane gas (STP) and fitted with dual 125 µm thick Teflon(TM) permeation windows. Tubes were maintained at 39°C.