

Prediction of methane emissions by domestic ruminants

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Equations have been published for the prediction of CH₄ emissions from level of feed intake (multiple of maintenance) and energy digestibility (1, 2), intake of dry matter by sheep (3) and intake of carbohydrate components by cows (4).

On average, of the reducing equivalents (2H) released during rumen fermentation, about 60% are used for CH₄ synthesis, 30% for volatile fatty acid (VFA) synthesis and 10% for microbial cell synthesis. Acetate (A) and butyrate (B) synthesis result in net 2H release; propionate (P) and valerate (V) synthesis result in net 2H uptake. Thus diet changes that decrease the VFA ratio $(A + B) / (P + V)$ would be expected to decrease CH₄ emissions; prediction equations should reflect such diet effects. The correlations of predictions with the VFA ratio for sheep given eight concentrate diets varying in protein level and degradability (5) are shown in the Table. To apply the equation of Moe and Tyrrell (4), feed intakes were multiplied by 10, the ratio of the 0.9 power of the liveweights of their cows and the sheep (6).

Equation	CH ₄ emitted (% gross energy)		Correlation (r) CH ₄ vs VFA ratio
	Mean	Range	
(1)	7.42	7.19 - 7.60	0.030
(2)	6.32	6.05 - 6.63	- 0.078
(3)	6.18	6.08 - 6.32	- 0.260
(4)	5.69	5.43 - 5.91	0.339

The predictions of equation (1) showed no correlation with the VFA ratios; equations (2) and (3) showed small but negative correlations. Only equation (4) showed a positive correlation but it was of relatively small magnitude. However, it is strictly applicable only to cattle given high quality diets. Thus, none of these empirical equations can be considered satisfactory. Better predictions could be obtained if equations were derived for forage, mixed and concentrate diets from measurements on animals fed to appetite to predict CH₄ emissions (% gross energy intake) as a function of level of intake, digestibility, dietary content of structural and non-structural carbohydrate and estimated microbial-N yield. The last factor is suggested because there was a strong negative correlation ($r = -0.82$) between an index of microbial synthesis and the VFA ratio (5); it can be calculated using one of the modern protein evaluation systems.

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