ESTIMATION OF ORGANIC MATTER DIGESTIBILITY AND ME CONTENT IN RUMINANT FEEDS FROM IN VITRO GAS PRODUCTION

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ABSTRACT

Cumulative gas production from incubation of feedstuffs with rumen liquor or a fresh faecal suspension as inoculum *in vitro* together with crude nutrient composition can be used to predict organic matter digestibility and metabolizable energy content of ruminant feeds with high accuracy. In this study, prediction equations were derived for roughages using 110 samples with known *in vivo* digestibility. It can be demonstrated, that the accuracy of prediction of the gas production method is better compared with a pepsin-cellulase procedure and that the use of a faecal suspension as inoculum is a useful alternative when fresh rumen liquor is not available.

KEYWORDS

In vitro digestibility, gas production, energy estimation, prediction equation

INTRODUCTION

Due to its ability to simulate the process of digestion in ruminants in a much better way than chemical methods, *in vitro* methods have been successfully used for the prediction of organic matter digestibility (OMD) and metabolizable energy (ME) content of ruminant feeds. These methods can be distinguished either according to the inoculum used, generally rumen liquor or enzyme preparations (cellulases), or according to the principle of measurement which is the apparent (Tilley and Terry, 1963) or the true unfermented residue (Van Soest et al., 1966) or the end products of fermentation. Among the latter principle, Menke et al. (1979) and Menke and Steingass (1987) have proposed a method using cumulative gas production from rumen fermentation *in vitro* as the main parameter for the estimation of OMD and ME-content of roughages and concentrates.

MATERIALS AND METHODS

Incubation is carried out in glass syringes (100 ml 1/1) fitted with a valve. Approximately 200 mg DM of sample is weighed, mixed with the inoculum and incubated at 39°C in a ventilated oven. Gas production is recorded after 24 or 48 hrs.

As **inoculum** 30 ml buffered fresh rumen liquor from fistulated ruminants fed a mixed diet containing 60-70 % good quality roughage is used. Alternatively a buffered suspension made of fresh faeces from sheep can be applied (Aiple et al. 1992).

Standardisation of the test is achieved 1) by elimination of the gas production from the inoculum (“blank”), 2) by standard feedstuffs with defined gas production that all users of the method should apply and 3) by a defined feeding of the donor animals.

Prediction equations for OMD were computed from 101 roughage feeds tested in standardized digestion trials with sheep. Equations for ME were derived from the same samples where ME-content was calculated from digestible nutrients (MAFF, 1975). In addition, 9 samples in which ME was measured in respiration trials with sheep were used. The sample pool consisted of 57 hays, 11 artificial dried grasses, 13 straws, 15 grass silages and 14 whole crop silages. The relationship between *in vivo* and *in vitro* measurements were examined by multivariate regression. The association between independent and dependent variables was expressed as the percentage of variance (R^2) and the accuracy of prediction in terms of its residual standard deviation (RSD) in % of y.

RESULTS AND DISCUSSION

Table 1 shows the prediction equations for the estimation of OMD and ME for the three laboratory methods. Equations for the original gas production method using rumen liquor as well as the modified method using a faecal suspension are given. As gas production mainly reflects carbohydrate degradation, the accuracy of the regression models can be increased by including other fractions from the proximate analysis, in particular protein and lipids. For the estimation of OMD the RSD values of the three procedures vary between 4,4 and 8,2 % and for the estimation of the ME content between 3,9 and 7,3%. Among the *in vitro* methods, the gas production method using rumen liquor shows the best results. Slightly less precise was the modification using a faecal suspension and the pepsin-cellulase method. As expected the largest error was found with the estimation based on crude nutrients. This comparison clearly demonstrates the superiority of “biological” methods over the estimations using crude nutrients only. Regarding labour required to carry out the methods, the gas production method has a clear advantage over the time consuming cellulase technique. The necessity of keeping fistulated animals to provide rumen liquor can be overcome by the modified procedure with a faecal suspension.

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Table 1
Prediction equations for OMD (%) and ME (MJ/kg DM) for three laboratory methods.

Eq. No.	Equation	R^2	RSD
	y = OMD (n=101)		
1	$y = 12,88 + 0,931\ GP/R_{24} + 1,932\ XL + 0,309\ XP + 0,511\ XA$	0,93	4,4
2	$y = 4,95 + 0,911\ GP/F_{48} + 2,045\ XL + 0,699\ XP + 0,498\ XA$	0,92	4,6
3	$y = 18,97 + 0,786\ DOMD_{cell} + 0,420\ XA$	0,87	6,0
4	$y = 87,18 + 2,389\ XL - 0,958\ XF$	0,75	8,2
	y = ME (n=110)		
5	$y = 2,06 + 0,141\ GP/R_{24} + 0,036\ XP + 0,374\ XL - 0,028\ XA$	0,95	3,9
6	$y = 0,98 + 0,135\ GP/F_{48} + 0,094\ XP + 0,402\ XL - 0,031\ XA$	0,93	4,7
7	$y = 1,50 + 0,098\ DOMD_{cell} + 0,036\ XL + 0,042\ XX$	0,91	5,2
8	$y = 13,82 + 0,402\ XL - 0,155\ XF - 0,135\ XA$	0,83	7,3

GP = gas production using rumen liquor (R) or faecal suspension (F), (ml/200 mg DM/24/48h)
$DOMD_{cell}$ = cellulase digestible organic matter in dry matter, (%)
XA, XP, XL, XF, XX = total ash, crude protein, -fat, -fiber, NfE, (% in DM)