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RELATIONSHIPS BETWEEN IN VITRO GAS PRODUCTION CHARACTERISICS AND COMPOSITION OF TREE LEAF FODDERS FROM BOLIVIA, WEST AFRICA AND COLOMBIA

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Introduction

Tree leaves are important fodders in many less developed countries, particularly in dry seasons when alternative feeds can be scarce. Although many leaves appear to be good quality fodders due to their generally high crude protein content, many contain anti-nutritive factors which reduce their nutritive value. Tannins are the most widespread of the anti-nutritive factors and are to be found in many tree species. An in vitro gas production method has been developed by Theodorou et al (1994) and applied to the ranking of tree leaf fodders (Wood et al, 1993). This paper combines data obtained from three separate pieces of work investigating the nutritive value of tree leaf fodders in Bolivia, West Africa and Colombia. It seeks to investigate relationships between in vitro gas production at various times of incubation and proximate composition, fibre and tannin content in order to identify which components are of particular importance in determining gas production characteristics and whether these relationships are consistent over a wide range of species from different sources.

Methods

Samples of tree leaf fodders from a wide range of species (20 from Bolivia, 26 from West Africa and 24 from Colombia) were oven dried at 50°C (Bolivian samples), at unspecified temperatures in different laboratories (West African samples) and 60-70°C (Colombian samples)and analysed for crude protein (CP), ash, ether extract (EE), ADF and NDF. Aqueous acetone extractable tannins were analysed for protein precipitation activity (PPA) by the radial diffusion method (Hagerman, 1987, as modified by Wood et al, 1994) , total phenols (TP) by the Prussian Blue method (Price and Butler, 1977) and condensed tannins (CT) by acid butanol (Porter et al, 1986). Samples were then fermented at 39°C for 166 hours using rumen microbes using the in vitro gas production technique of Theodorou et al (1994). At the end of the incubation period the residues were recovered by filtration and the dry matter dissappearance (DMD) estimeated. The relationships between in vitro gas production variables and composition were investigated using step wise multiple regression analysis. Gas production variables investigated were cumulative gas production after 6, 12, 24 and 52 hours incubation, DMD after 166 hours incubation, and the rate constant (k) produced by fitting an exponential curve to the gas production data.

Results

Table 1 shows which variables (components) were selected by multiple regression analysis as having an influence on the particular gas production parameter. ADF and extractable tannins as measured by the TP assay were selected as accounting for variability in cumulative gas production at all the times investigated and in DMD. ADF and TP were inversely related to the gas production parameters. CP was significant (negatively related) only in the 6 hour cumulative gas production data. Components accounting for variability in k were ash, ether extract (both positively related), NDF (which was closely related to ADF) and TP (both negatively related). For all gas production parameters, the source of the samples appeared to affect the relationship between gas production and composition, generally by affecting the relationship between TP and gas production. TP was a more accurate indicator of the effect of tannins on gas production than PPA or CT. In no case did the components measured account for even as much as 50% of the variability in gas production, so clearly other parameters were important.

Table 1 Components (indicated by *) which affect gas production parameters

	CG6[a]	CG12[a]	CG24[a]	CG52[a]	DMD[b]	k[c]
ash						*
EE[d]						*
NDF[d]						*
ADF[d]						
CP[d]						
TP[d]	*	*	*	*	*	
source[e]		*			*	
TP x source[e]		*	*	*		*

notes [a] CG6 = cumulative gas production after 6 hours incubation
CG 12 = cumulative gas production after 12 hours incubation etc
[b] DMD = dry matter dissappearance by filtration after 166 hours incubation
[c] k = rate constant derived by fitting an exponential equation to cumulative gas production data from 12 hours to 166 hours incubation
[d] EE = ether extract; NDF = neutral detergent fibre; ADF = acid detergent fibre; CP = crude protein; TP = total phenols.
[e] source = source of sample i.e. Bolivia, West Africa or Colombia.

Discussion and conclusions

Inverse relationships between gas production and both fibre and tannin contents have been found by other workers (for example, Nsahlai et al, 1994), therefore it was to be expected that these factors would be selected in this analysis. The finding that the TP assay is a better indicator of the effect of tannins than PPA and CT was in agreement with the findings Wood and Plumb (1994). Factors not analysed here were lignin and insoluble tannin (proanthocyanidin) contents which recent work indicates are of importance (Nsahlai et al, 1994). It was unclear why the source of the samples apparently affected the influence of TP on gas production. This may have been due unidentified site specific components, site-specific differences in phenols or differences in sample preparation.

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