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Tropical Plants Containing Condensed Tannins Inhibit Ruminal Methanogenesis In Vitro

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Tropical plants are characterized by a high content of secondary compounds such as condensed tannins (CT). Condensed tannins, depending on their chemical structure and concentration, are able to reduce enteric methane (CH_4) but they might also have adverse effects on rumen fermentation. An in vitro experiment was performed using 3 tannin-rich plants (TRP) largely available in the tropics to determine CH_4 production and fermentation parameters using a dose-response approach.

Tannin-rich *Glyricidia sepium* (G), *Leucaena leucocephala* (L), and *Manihot esculenta* (M) leaves were used as substrates for in vitro incubations. Their CT content was 75, 39, 92 g/kg dry matter, respectively. These substrates were incubated alone or mixed with tannin-free grassland hay (C), so that proportions of TRP were 0:100, 25:75, 50:50, 75:25 and 100:0. Three series of incubations were carried out for 24 h using ruminal fluid taken from 3 rumen-cannulated Texel wethers before morning feeding. Total gas, CH_4 and volatile fatty acids (VFA) were analysed at the end of the incubation. Fermented organic matter (FOM) was calculated from VFA production according to a stoichiometric equation. Statistical analyses were performed using the mixed procedure of SAS with plant, dose, plant x dose interaction as fixed effects and series as random effect. Linear, quadratic and cubic contrasts were determined for dose effect.

Table 1. Gas and CH_4 production (mL/24h), VFA concentration (m*M*) and composition of rumen liquid of sheep fed a control grassland hay (C) or tannin-rich plants *Leucaena leucocephala* (L), *Glyricidia sepium* (G) and *Manihot esculenta* (M)

	C	L				G				M					
Dose, %	0	25	50	75	100	25	50	75	100	25	50	75	100	s.e.	Effects
Gas	66.2	60.0	59.1	56.3	54.5	65.3	64.1	60.7	64.6	65.9	56.9	53.0	48.2	4.68	P D (l) I
CH_4	18.1	15.7	15.4	13.2	12.4	16.8	16.7	15.6	17.3	17.2	14.7	13.8	12.5	1.23	P D (l)
VFA	59.8	59.2	52.4	50.8	48.2	60.9	58.4	57.0	52.8	61.5	54.9	47.4	32.9	3.05	P D (l, q) I
VFA, mol/100 mol															
C2	66.4	66.3	61.4	62.2	61.6	65.1	61.7	63.6	62.5	64.3	67.3	66.4	63.8	2.39	-
C3	20.4	20.3	21.2	20.8	20.1	20.7	21.0	20.0	20.1	20.2	17.9	17.2	16.4	0.81	P
C4	6.4	6.2	7.3	7.3	7.8	6.7	7.5	6.8	7.0	7.3	7.3	7.4	8.3	0.68	-
C2:C3	3.3	3.3	2.9	3.0	3.0	3.2	3.0	3.2	3.1	3.2	3.8	4.0	4.0	0.28	P
FOM,%	50.6	49.2	43.7	42.4	40.7	51.2	49.1	48.3	44.7	51.5	46.2	40.4	28.3	2.74	P D (l, q) I

C2= acetate, C3= propionate, C4= butyrate
Statistical effects are mentioned when $P<0.01$. P=nature of TRP; D=dose (i.e., proportion of TRP in the fermented substrate); I = interaction between P and D. Analysis of contrasts: l=linear, q=quadratic (cubic contrasts were not significant)

This experiment confirms the potential of TRP for limiting CH_4 production, as shown in vivo with the same plant species (Rira *et al* 2013). Tannin-rich plants also decreased VFA production and thus FOM decreased too, especially for M. However, while the effect on VFA was observed at TRP concentrations of 50% or more, the effect on CH_4 was observed at a lower concentration. The global effect of CT was more pronounced for L and M than for G, because of a lower concentration in CT in this latter TRP, without significant interaction between dose and TRP type. The response to increasing doses of TRP was linear for most variables. This *in vitro* experiment provides new insights on the role of tannin content on CH_4 and VFA production.

Rira M., Marie-Magdeleine C., Archimède H., Morgavi D.P. and Doreau M. (2013). *In* "Energy and protein metabolism and nutrition in sustainable animal production" (Eds J.W. Oltjen, E. Kebreab and H. Lapierre) p. 501-502 (Wageningen Acad. Publ.: Wageningen, the Netherlands).

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