



Quebracho condensed tannins fed to dairy goats: effect on milk fatty acids and their use for CH₄ prediction

M. Battelli¹, F. Scicutella², G.M. Crovetto¹, A. Buccioni², L. Rapetti¹

¹Dep. of Agricultural and Environmental Sciences, University of Milan, Milan, Italy
²Dip. di Biotecnologie Agrarie sez. Scienze Animali, University of Florence, Florence, Italy

Introduction

Condensed tannins (CT) are plant polyphenols able to modify rumen fermentations. The inclusion of CT in the diet of ruminants can lead to a reduction of CH₄ production, modification of ruminal fermentations, biohydrogenation, and, consequently, of milk fatty acid (FA) composition. The aims of the study were:

- 1) to test the effect of different levels of dietary inclusion of quebracho CT extract on goat milk FA composition
- 2) develop prediction equations for CH₄ emission of goats using milk FA.

Materials and methods

- Eight multiparous lactating Alpine goats
- Repeated 4x4 Latin square design
- 24 d diet adaptation plus 4 d data collection with individual respiration chambers
- Four dietary inclusion levels (0, 2, 4, 6%) of commercial quebracho CT extract (CT content: 74.1% on DM)
- Milk FA composition analysed by gas chromatography
- Linear effect of CT on FA composition calculated by polynomial contrasts with PROC MIX, using square, period, and treatment as fixed effects and the animal as random effect.
- Multivariate models developed using the stepwise procedure. Only variables with $P < 0.05$ were retained in the final models.

Table 1: Milk fatty acid profile (g/100 g of total FA)

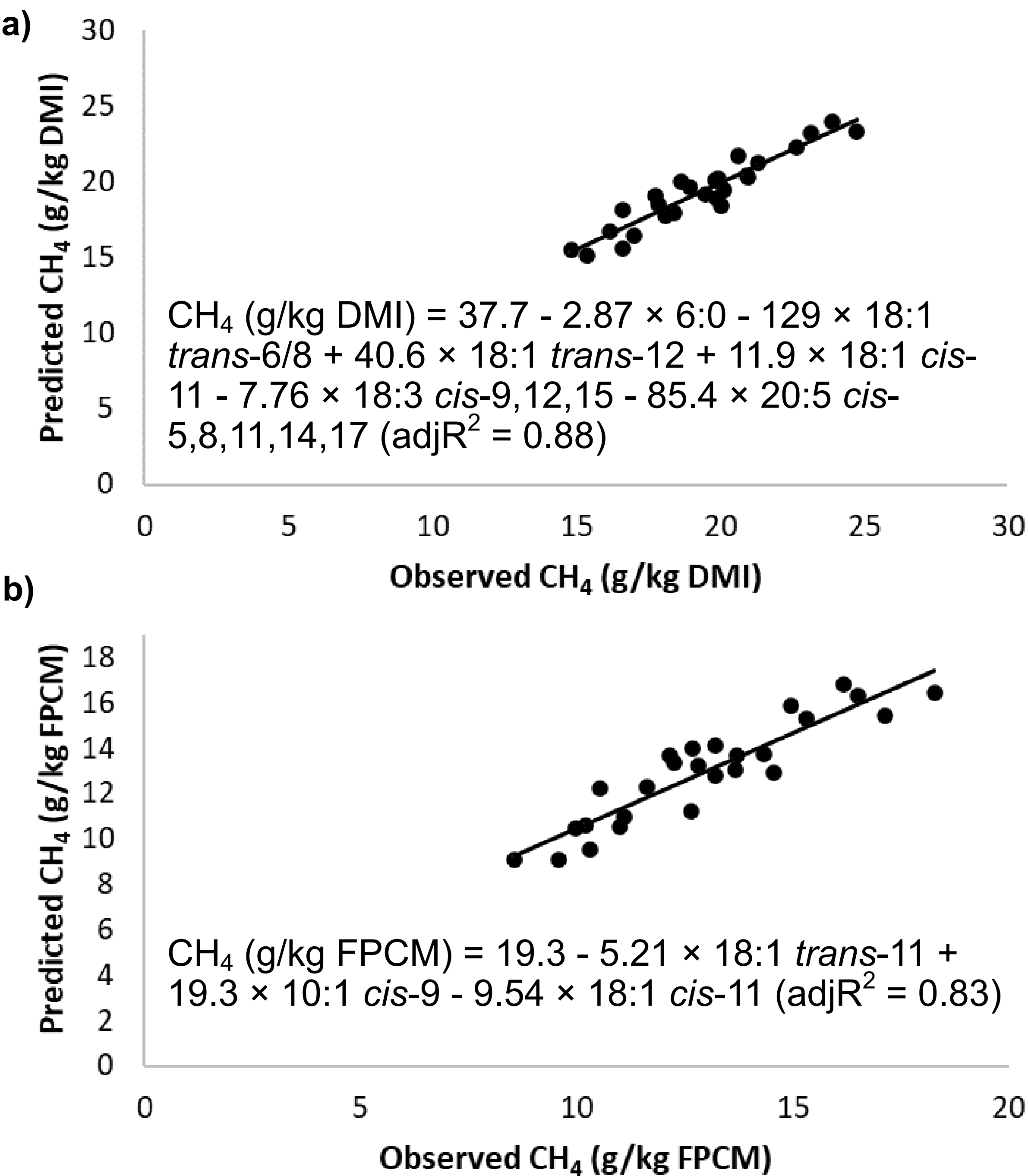
	Diets ¹				SEM	P Lin ²
	C	Q2	Q4	Q6		
SFA ³	62.6	60.1	62.6	60.2	1.80	0.453
4:0	2.28 ^b	2.20 ^b	2.38 ^a	2.45 ^a	0.040	<0.001
6:0	2.01	2.01	2.15	2.08	0.075	0.282
8:0	3.04	3.00	3.29	3.04	0.171	0.689
10:0	10.4	9.62	10.5	9.14	0.712	0.304
12:0	4.83	4.48	4.84	4.05	0.317	0.103
14:0	5.98	5.50	5.90	5.11	0.384	0.111
15:0	0.502 ^{ab}	0.480 ^b	0.510 ^{ab}	0.551 ^a	0.021	0.029
16:0	17.8	16.8	17.2	16.9	0.513	0.187
18:0	13.5 ^c	14.0 ^{ab}	13.7 ^{bc}	14.5 ^a	0.373	0.005
MUFA ⁴	21.5	22.9	22.0	24.3	1.32	0.109
10:1 <i>cis</i> -9	0.150	0.156	0.175	0.162	0.014	0.375
14:1 <i>cis</i> -9	0.044	0.044	0.047	0.049	0.003	0.126
18:1 <i>cis</i> -9	17.7	19.1	18.0	20.0	1.18	0.173
18:1 <i>cis</i> -11	0.362	0.380	0.380	0.424	0.024	0.016
18:1 <i>trans</i> -6/8	0.137 ^b	0.139 ^b	0.150 ^a	0.158 ^a	0.006	<0.001
18:1 <i>trans</i> -11	1.08 ^{bc}	1.03 ^c	1.16 ^{ab}	1.22 ^a	0.053	0.003
18:1 <i>trans</i> -12	0.245 ^b	0.263 ^{ab}	0.279 ^a	0.272 ^a	0.010	0.012
PUFA ⁵	4.91 ^c	5.14 ^{bc}	5.65 ^b	6.37 ^a	0.312	<0.001
18:2 <i>cis</i> -9,12	3.53 ^c	3.76 ^{bc}	4.15 ^b	4.69 ^a	0.025	<0.001
18:3 <i>cis</i> -9,12,15	0.603 ^b	0.618 ^b	0.687 ^b	0.786 ^a	0.046	<0.001
20:5 <i>cis</i> -5,8,11,14,17	0.039	0.042	0.044	0.051	0.004	0.028
DI ⁶	0.007 ^b	0.008 ^b	0.008 ^b	0.010 ^a	0.001	0.008
<16:0 ⁷	48.0	45.3	48.0	44.8	1.87	0.293
>16:0 ⁸	40.9 ^b	42.9 ^{ab}	42.3 ^b	46.0 ^a	1.53	0.014

^{a-c}Mean values in the same row with different superscripts differ ($P < 0.05$). ¹Diets with different levels of quebracho condensed tannin (CT) extract: C = no CT extract; Q2, Q4, Q6 = 2, 4, 6% CT extract on DM, respectively. ²Linear effect of CT inclusion. ³SFA: saturated linear chain fatty acids (FA). ⁴MUFA: monounsaturated FA. ⁵PUFA: polyunsaturated FA. ⁶DI: desaturation index ($14:1 \text{ cis-9} / (14:0 + 14:1 \text{ cis-9})$). ⁷<16:0: de novo FA. ⁸>16:0: preformed FA.

Results and discussion

- CT inclusion increased, among others, the concentrations of 4:0, 15:0, 18:0, 18:1 *trans*-11 (*trans*-vaccenic), 18:2 *cis*-9,12 (linoleic), 18:3 *cis*-9,12,15 (α -linolenic), PUFA, and the desaturation index (Table 1).
- CH₄ emission can be predicted with the equations reported in Figure 1 when goats are fed CT.

Figure 1: Observed and predicted CH₄ emissions relative to (a) g/kg DMI, (b) and g/kg FPCM based on milk FA



Conclusions

Quebracho CT influenced milk FA profile, particularly increasing the concentration of preformed FA, and of FA positively linked to benefits for human health. Milk FA were good predictors of CH₄ emissions in goats fed quebracho CT.

Acknowledgments

Project support was provided by the Regione Lombardia, PSR 2014–2020 Operazione 16.1.01 Gruppi Operativi PEI, d.d.s. 2951/2018.