Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: http://www.tandfonline.com/loi/tjas20

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To cite this article: Stefania Colombini, Gianni Colombari, Gianni Matteo Crovetto, Gianluca Galassi & Luca Rapetti (2009) Tannin treated lucerne silage in dairy cow feeding, Italian Journal of Animal Science, 8:sup2, 289-291, DOI: 10.4081/ijas.2009.s2.289

To link to this article: https://doi.org/10.4081/ijas.2009.s2.289

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Published online: 07 Mar 2016.

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Tannin treated lucerne silage in dairy cow feeding

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ABSTRACT - The effects of the addition of tannins to lucerne silage were investigated. At ensiling, chestnut hydrolyzable tannins were added to lucerne forage (T=tannins treated lucerne silage vs C=control lucerne silage). Fifty lactating Holstein cows, fed two diets different for lucerne silage treatment (C or T), were used in a cross-over design. In situ rumen soluble protein fraction (%CP) was higher for C (67.9 *vs* 59.4; P<0.01), whereas potentially rumen degradable protein (%CP) was lower (24.5 *vs* 32.1 for C and T; P<0.01). Intestinal rumen escape protein digestibility (%) was numerically higher for T (48.3 *vs* 54.3). Dry matter intake (21.5 kg/d for both diets) and milk yield (29.8 and 30.2 kg/d for C and T) were not affected by dietary treatment, whereas FCM was slightly higher for T diet (27.5 *vs* 27.9 kg/d for C and T; P<0.10). Adding tannins to lucerne silage is effective in shifting part of N utilization from the rumen to the intestine, leading to similar productive performance in lactating cows.

Key words: Lucerne silage, Tannins, Milk production.

Introduction – Lucerne is a highly-nutritious and high-yielding forage legume characterized by a great crude protein (CP) content highly degradable in the rumen. There has been a growing interest in developing novel ways to reduce the rate of rumen protein degradation such as the addition of tannins. Tannins are secondary plant metabolites that can bind proteins at ruminal pH, preventing bacterial proteolysis, whereas they can allow protein release at abomasum level (Tabacco *et al.,* 2006). Inconsistent results on the effects of tannins on protein digestion and absorption in the lower gut are described (Carulla *et al.,* 2005). The aim of the present work was to evaluate the effect of the addition of hydrolyzable chestnut tannins to lucerne silage on: 1) silage fermentation quality, nitrogen solubility and availability; 2) milk yield and quality of cows fed diets with the lucerne silage.

Material and methods – A fourth regrowth of lucerne (ecotype Delta) was cut at early bloom stage, field-wilted and harvested the following day. Lucerne was ensiled in two bunker silos (C=Control and T=Tannins) and chestnut hydrolyzable tannins (Tannino C, Silva Chimica, s.r.l., Italy) were added only to the T forage to have a final concentration of 4.6% on DM. No lactobacilli inoculum or organic acids (such as formic or propionic) were added. After 130 days of conservation silos were opened and silages were sampled and analysed. DM and nitrogen rumen degradability were determined with the in situ method (NRC, 2001). Intestinal protein digestibility was determined by the method of Calsamiglia and Stern (1995). Organic matter digestibility was predicted by gas production (Menke and Steingass, 1988).

Fifty lactating Holstein cows fed two diets different for lucerne silage treatment (C or T) were used in a cross-over design. The experimental diets contained (DM basis): 29.2% lucerne silage, 30.1% maize silage, 6.9% grass hay, 17.0% maize meal, 9.3% soy bean meal, 5.7% barley meal and 1.8% mineral and vitamin supplement. Diets were formulated to have CP, NDF and starch contents of 15.2, 34.3 and

24.2% on DM, respectively. Tannins concentration in the T diet was 1.3% on DM. Each experimental period consisted of 21 d of adaptation and 7 d of sample collection. Individual milk yield was registered at every milking and individual milk samples were analysed for fat, protein, lactose and somatic cells (expressed as linear score, LS). Diets and forages were analysed for chemical composition. Data were analysed using Proc GLM procedures by SAS (2000). The kinetics of rumen degradability were calculated from the Ørskov and McDonald (1979) equation.

Results and conclusions – C and T silages had respectively: DM 46.9 *vs* 47.8%; pH 5.1 *vs* 5.0; lactic acid 2.5 *vs* 2.8% DM; acetic acid 2.5 *vs* 2.4% DM. In both silages the ratio lactate/acetate was quite low; an explanation is that no *Lactobacillus* inoculum was applied at ensiling. Butyric and propionic acids were not detected and overall both silages were well fermented. CP content (% on DM) was similar between silages (19.9 C and 19.7 T) but forages differed for N solubility according to CNCPS model: fraction A (%CP) was higher in C silage (62.4 *vs* 56.3), whereas B1, B2 and B3 (%CP) were lower in comparison with T silage (0.8 *vs* 3.0; 24.8 *vs* 28.9; 1.5 *vs* 4.6%, respectively). Nitrogen ammonia (% total N) of C and T silages was 9.6 and 9.3, respectively. No effect of tannins on NH_3-N content was observed in contrast with Tabacco *et al.* (2006). However, in the latter study, lucerne was ensiled with an average DM content of 35% and underwent greater fermentation process. The lack of effect in this study is probably due to the higher DM content of the silages. It is worth pointing out that NH_3-N is negatively correlated to DM (Colombini *et al.,* 2008). Table 1 reports rumen degradability of DM, N and nitrogen intestinal digestibility. The addition of tannins resulted in a significant decrease of soluble protein fraction (a) and in a significant increase in the potentially rumen-degradable protein fraction (b) consistently with the results reported by Tabacco *et al.* (2006) and Santos *et al.* (2000). As a result, the total potential degradability of CP was similar for both silages. The rate of degradability (%/h) of the potentially degradable protein was lower for T silage (7.5 *vs* 8.2; P<0.10). The effective rumen protein degradability both at 3 and at 6%/h rate of passage, was reduced by tannin treatment (P<0.01). Intestinal protein digestibility was numerically higher for T. Tannins reduce proteolysis in the rumen as they make protein complexes resistant at the pH of the rumen, but unstable in the acid environment of the abomasum; thus, more digestible proteins are available at gut level (McSweeney *et al.,* 2001).

Table 1. DM and protein rumen degradability and intestinal crude protein digestibility (% by pass CP) of control and tannin-treated lucerne silage.

		DM				CP			
		C	T	ES	P	C	T	ES	P
a	%	35.2	38.0	0.18	0.01	67.9	59.4	0.52	0.01
b	%	38.8	37.5	0.03	0.01	24.5	32.1	0.65	0.01
Kd	%/h	7.5	7.1	0.30	ns	8.2	7.5	0.15	0.10
a + b	%	74.1	75.5	0.15	0.05	92.4	91.5	0.17	ns
ED	3%/h	62.9	64.3	0.28	ns	85.8	82.3	0.13	0.01
ED	6%/h	62.9	64.3	0.34	ns	82.0	77.3	0.20	0.01
Intestinal dig	%					48.3	54.3	---	

Fraction a=soluble fraction; fraction b=potentially rumen-degradable fraction; ED 3%=Effective degradability with a rate of passage of 3%/h; ED 6%=Effective degradability with a rate of passage of 6%/h.

Considering the effect of tannins on rumen fermentability (in terms of gas production, GP) T treatment decreased GP (ml/200 mg DM) both at 8 (22.7 *vs* 17.6 for C and T) and 24 hours (37.4 *vs* 33.9) and hence organic matter rumen digestibility (67.8 *vs* 63.1%) as found by Tabacco *et al.* (2006), whereas Getachew *et al.* (2008) showed that the effect of tannins on rumen fermentation varied with type and level of tannins. Reductions in DM digestibility, however, have been observed in vivo only when forages containing over 5% DM condensed tannin were fed (Waghorn *et al.*, 1990). High concentrations of tannins are also reported to reduce feed palatability and nutrient availability (Pritchard *et al.,* 1992). In

Table 2. Milk yield and quality of cows fed C and T diets.

		C	T	SE	P
Milk	(kg/d)	29.8	30.2	0.19	ns
Fat	(%)	3.57	3.58	0.22	ns
Protein	(%)	3.34	3.36	0.02	ns
Lactose	(%)	4.91	4.93	0.01	ns
FCM	(kg/d)	27.5	27.9	0.16	<0.10
Fat	(g/d)	1037	1057	7.5	<0.10
Protein	(g/d)	965	984	5.7	<0.05
LS		3.34	3.31	0.12	ns

this experiment dietary concentration of tannins in T diet was low (1.3% on DM) and DM intakes were 21.5±1.0 (diet C) and 21.5±0.6 (diet T). Milk yield (table 2) was not affected by dietary treatment, consistently with the results of Benchaar *et al.* (2008), whereas FCM was slightly higher for T diet (P<0.10). Milk quality was unaffected by diet (table 2).

In conclusion, the data obtained suggest that a treatment of lucerne silage with 4-5% tannins on DM is effective in shifting part of N utilization from the rumen to the intestine. Moreover, tannins slightly decrease rumen fermentation but enhance protein intestinal digestibility. There is an overall compensation between positive and negative effects of tannins which leads to similar productive performance in lactating cows fed diets with about 30% C or T lucerne silage on DM.

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