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Effect of the type of forage (pasture *vs*. hay) and the inclusion of condensed tannins in ewe's diet on milk quality and suckling lamb's growth

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Abstract. The aim of this study was to assess the effects of the type of forage and the inclusion of condensed tannins (CT) on productive parameters of lactating ewes and the lamb's growth. Thirty-nine Churra Tensina ewe-lamb pairs were used in a 2 x 2 experimental design, with two types of forages: Pasture *vs*. Hay; and two concentrates: a concentrate with 10% of Quebracho (SYLVAFEED ByPro Q, Spain) extract with 75% of CT (CT) and a control concentrate without CT (Control). At parturition, ewes were randomly distributed according to their body-weight (average 46.6 kg), body condition score (average 2.43) and lambing date (4-Apr.). Ewes were daily fed 300 g of concentrate plus *ad libitum* forage. The experimental period lasted 35 days. Pasture ewes had greater daily milk production and protein content than hay-fed ones (1.31 *vs*. 1.00 l/d and 5.1 *vs*. 4.6%, for milk production and protein content, respectively) but had similar fat content (average 6.4%, P>0.05). The inclusion of CT in the concentrate did not affect milk production (P>0.05) or fat content (P>0.05), but influenced the protein content of milk (4.8 *vs*. 5.0%, for CT and Control, respectively; P<0.05). Lamb growth during lactation was greater in Pasture than in Hay lots (280 *vs*. 220 g/d, respectively; P<0.001), regardless of the inclusion of CT. In conclusion, pasture forage improved milk production and composition and lamb growth, whereas the addition of condensed tannins in the ewe diet only had effect on the protein content of milk, decreasing its content.

Keywords. Condensed tannin – Milk production – Suckling lamb – Pasture.

Effets du type de fourrage (pâturage* vs. *foin) et de l'inclusion des tanins condensés dans l'alimentation des brebis sur la qualité du lait et sur la croissance des agneaux en allaitement

Résumé. *Le but de cette étude était d'évaluer les effets du type de fourrage et l'inclusion de tanins condensés (CT) sur les paramètres de production des brebis en lactation et sur la croissance des agneaux. Trente-neuf Churra Tensina paires brebis-agneau ont été utilisés dans un modèle expérimental 2 x 2, avec deux types de fourrages : pâturage* vs. *foin ; et deux types de concentrés : un concentré avec 10% de Quebracho (SYLVA FEED ByPro Q, Espagne) avec 75% de tanins condensés (CT)* vs. *un concentré sans inclusion de tanins (Control). À la mise bas, les brebis ont été réparties de façon aléatoire en fonction de leurs poids vifs (en moyenne 46,6 kg), note d'état (moyenne 2,43) et la date d'agnelage (4 avril). Les brebis ont été alimentées quotidiennement par 300 g de concentré avec du fourrage à volonté. La période expérimentale s'est étalée sur 35 jours. Les brebis sur pâturage ont eu une production laitière journalière et une teneur en protéines plus élevées que les brebis alimentées par le foin (1,31* vs. *1,00 l/j et 5,1* vs. *4,6%, respectivement pour la production de lait et la teneur en protéines). Par contre, la teneur en matière grasse était similaire pour tous les lots (moyenne de 6,4%, P>0,05). L'introduction des tanins condensés dans le concentré n'a affecté ni la production du lait (P>0,05) ni la teneur en matière grasse (P>0,05), mais a affecté la teneur du lait en protéines (4,8* vs. *5,0%, respectivement pour CT et Control ; P<0,05). La croissance des agneaux pendant l'allaitement était plus élevée sur pâturage qu'avec le foin (respectivement 280 et 220 g/j ; P<0,001), indépendamment de l'inclusion des Tanins Condensés. En conclusion, le pâturage améliore la production du lait des brebis, sa composition et la croissance des agneaux en allaitement. Alors que l'introduction des tanins condensés dans la ration des brebis n'a pas d'effet sur la teneur en protéines du lait, en diminuant son contenu.*

Mots-clés. *Tanins condensés – Production du lait – Allaitement des agneaux – Pâturage.*

I – Introduction

Consumers of Mediterranean countries demand meat of young lambs, suckling or light lambs (Sañudo *et al.*, 1998). Ewes are usually stalled around parturition and they are hay-fed during lactation while the suckling lambs are fed exclusively maternal milk from birth to slaughter (average age of 40 days and body weight of 10-12 kg). However, grazing is an interesting alternative to stall-feeding (Joy *et al.*, 2012). The inclusion of condensed tannins in ewe's diet has been studied to modify ruminal fermentation to reduce greenhouse gas emissions (Pellikaan *et al.*, 2011). Nevertheless, condensed tannins might change the fatty acid profile of the milk (Toral *et al.*, 2013) and milk production (Wang *et al.*, 1996). Consequently, lambs performance might also be affected.

The aim of this study was to evaluate the effect of two types of forages (pasture *vs.* hay) and the inclusion of condensed tannins in the concentrate fed to Churra Tensina lactating ewes on milk production and composition and the performance of the suckling lamb.

II – Material and methods

The experimental and slaughter procedures used met the guidelines of Council Directive 86/609/EEC on the protection of animals used for experimental and other scientific purposes. Spring-lambing adult ewes of Churra Tensina breed (n = 39; At lambing: age: 6.9 ± 0.54 yr; body-weight (BW): 47 ± 1.0 kg; 2.4 ± 0.05 body condition score (BCS)) and their single-reared lambs (At birth: BW: 4 ± 0.1 kg) were used in a 35-day feeding trial. At parturition, ewe-lamb pairs were randomly distributed, according to their BW, BCS and age, to 1 of 4 treatments in a 2 x 2 factorial experimental design, with 2 forages: Pasture *vs.* Hay; and 2 pelleted concentrates: a concentrate with 10% of Quebracho extract (SYLVAFEED ByPro Q, Spain) *vs.* a concentrate without condensed tannin (Control). As the extract contained 75% of condensed tannins, the CT inclusion in the concentrate was 7.5%. Pasture dams and lambs had access to a permanent pasture, which was sampled weekly (239 g crude protein (CP)/kg dry matter (DM), 175 g of neutral detergent fibre (NDF)/kg DM and 16.45 MJ metabolisable energy (ME)/kg DM). Stall-fed dams and lambs were fed hay on *ad libitum* basis (69 g CP/kg DM, 633 g NDF/kg DM and 8.24 MJ ME/kg DM). The concentrates were available only for dams, which were daily fed 300 g. Half of the dams of each type of forage were fed the CT concentrate (141 g CP/kg DM, 175 g NDF/kg DM and 16.45 MJ ME/kg DM) while the other half were fed the Control concentrate (140 g CP/kg DM, 249 g NDF/kg DM and 15.13 MJ ME/kg DM). Lambs suckled their dams and had access to pasture or hay. Water and mineral blocks were offered *ad libitum.*

Milk production was recorded weekly by the oxytocin technique (Donney *et al.*, 1979).The milk obtained in the second milking (4 h interval) was weighed and yield was extrapolated to the daily period (daily milk yield = milk obtained x 6). A sample was preserved with $K_2Cr_2O_7$ to determine the chemical composition (Milkoscan 4000). Milk yield was standardized: Standard milk yield (l/d) = milk yield (l/d) x ((0.0071 x crude fat (g/l)) + (0.0043 x CP (g/l)) + 0.2224 (Bocquier *et al.*, 1993).

Animals were weekly weighed at 8:00 am. Lambs average daily gain (ADG) was estimated by linear regression of BW against time. When lambs reached 10-12 kg BW they were transported (180 km) to the experimental abattoir. At arrival, lambs were weighed and slaughtered. After slaughter, hot carcass weight (HCW) was registered and carcasses were chilled 24 h at 4 ºC in total darkness. Cold carcass weight (CCW) was registered and dressing percentage was calculated as the ratio of CCW to BW at slaughter.

Data were analysed using the SAS statistical software (V.9.3). Milk production and quality were analysed using mixed models for repeated measures with forage type, CT in the concentrate, week of lactation and their interactions as fixed effects and ewe as random effect. Lamb performance and carcass traits were analysed with a general linear model with the type of forage, CT in the concentrate and their interaction as fixed effects. Least square means and the standard errors were obtained. Multiple comparisons among treatments were performed by the Tukey's method. The level of significance was set at 0.05.

III – Results and discussion

Milk production evolved differently in pasture and hay-fed ewes (P<0.05) (Table 1). Milk production was similar in the 1st and 2nd week of lactation but pasture ewes had greater milk production than hay-fed ewes in the 3rd, 4th and 5th week of lactation. The type of forage had an effect on standard milk yield and protein content (P<0.001) but did not affect fat content, lactose and somatic cells count (P>0.05). Milk yield and composition under pasture conditions is highly variable. In fact, in previous works under similar conditions, pasture ewes had greater milk production and fat and protein content than hay-fed ewes (Joy *et al.*, 2008) or they did not differ between pasture and hay-fed ewes (Joy *et al.*, 2012).

Table 1. Effect of the type of forage, the inclusion of condensed tannins (CT) in the concentrate and the week of lactation on milk yield and quality of Churra Tensina ewes

	Forage (F)		Concentrate (C)†			P-Values			
	Hay	Pasture	CT	Control	SE	F	C	Week	Week x F
Number of animals	19	20	18	21					
Milk yield (l/d)	1.01	1.32	1.21	1.12	0.04	***	NS	*	*
Standard milk yield (l/d)	0.88	1.12	1.08	0.92	0.04	***	NS	NS	NS
Fat content (%)	6.50	6.35	6.57	6.29	0.19	NS	NS	***	NS
Protein (%)	4.68	5.12	4.78	5.01	0.07	***	*	*	NS
Lactose (%)	5.06	5.08	5.06	5.08	0.03	NS	NS	***	NS
Log_SCC††	2.41	2.35	2.28	2.48	0.09	NS	NS	*	NS

† CT: with 10% of quebracho with 75% CT, Control: without CT; ††Somatic cells count; NS: no significant; * P<0.05; *** P<0.001.

The inclusion of CT in the concentrate did not affect milk yield and composition (Table 1; P>0.05), except for milk protein content (P<0.05). Ewes receiving CT concentrate had less protein content in milk than ewes fed control concentrate (P<0.05). Similarly to our results, milk protein concentration decreased with 1.8% tannin extract from Quebracho and Chestnut supplementation, whereas 0.45% CT extract supplementation increased milk protein in dairy cows (Aguerre *et al.,* 2010). The lack of effect on milk production in the current study agrees with the results reported by Toral *et al.* (2013), who did not observe an effect on milk production when 2% of quebracho was added in the diet of dairy ewes.

Milk composition was affected by the week of lactation (P<0.05). The milk of the 1st week of lactation had greater content of fat, crude protein and SCC (P<0.05) but lower lactose content than the milk of the following weeks, with no differences among them (P>0.05).

The type of forage offered to the ewes during lactation affected most of the parameters studied in lambs (Table 2).

Pasture lambs had greater ADG, BW at weaning and slaughter (P<0.05) than Hay lambs. The greater ADG of pasture lambs was due to the higher milk production of pasture than hay-fed dams, which is in agreement with the result observed by Joy *et al.* (2012). The average age of lambs at slaughter was not affected by treatment of type of forage (P>0.05). Pasture lambs had heavier carcasses and higher dressing percentage than lambs from hay-fed lambs due to the positive correlation between weight and dressing percentage (Velasco *et al.*, 2000). The inclusion of CT in the concentrate did no have effects on lamb performance (P>0.05). The lack of differences is probably due to the similar milk production of the dams.

Table 2. Effect of the type of forage and the inclusion of condensed tannins (CT) in the concentrate on lamb performance and carcass characteristics

	Forage (F)		Concentrate†			P-Values	
	Hay	Pasture	CT	Control	SE	Forage	Concentrate
Number of animals	19	20	18	21			
Average daily gain (kg/d)	0.22	0.28	0.26	0.24	0.02	***	NS
Body weight (kg)							
At lambing	3.71	3.41	3.61	3.51	0.25	NS	NS
At weaning	10.98	11.75	11.28	11.45	0.32	*	NS
At slaughter	10.61	11.56	11.06	11.11	0.32	***	NS
Age at slaughter (d)	34.91	32.13	31.78	35.26	2.82	NS	NS
Hot carcass weight (HCW) (kg)	6.26	6.98	6.67	6.56	0.28	***	NS
Cold carcass weight (CCW) (kg)	5.98	6.75	6.41	6.32	0.24	***	NS
Dressing percentage (%)	56.31	58.44	57.99	56.77	1.30	*	NS

† CT: with 10% of quebracho with 75% CT, Control: without CT; NS: no significant; * P< 0.05; *** P < 0.001.

IV – Conclusions

In these conditions, pasture improved milk production and composition and lamb performance, so it can be a good alternative to hay-feeding of lactating ewes. Moreover, it is economically more efficient because it uses natural resources directly without food processing, and besides it satisfies consumers demands for healthy and safe products. A concentrate with 10% of quebracho can be used in the lactating ewe without effects on ewe and lamb performance.

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