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Milk production and quality in Sicilo-sarde ewes drenched with *Artemisia herba alba* or *Rosmarinus officinalis* essential oils

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Abstract. This study aimed to determine the effect of oral administration of essential oils (EOs) extracted from the foliage of *Artemisia herba alba* (ART) and *Rosmarinus officinalis* (ROS) to Sicilo-sarde ewes on milk yield and quality.Thirty ewes were divided into three equivalent groups on the basis of liveweight, lactation rank and litter size, and housed in individual boxes. Each animal received oat hay and barley silage *ad libitum* and 500 g of concentrate for 60 days. The control group did not receive EOs, whereas the ART group was drenched with 200 mg of Artemisia EOs/kg DM intake and those of the ROS group with 200 mg of Rosmarinus EOs/kg DM intake. Neither ART nor ROS essential oils affected the rumen fermentation parameters in ewes. Drenching feeds with ART essential oils increased milk density, fat-free dry matter content, total protein, and polyunsaturated fatty acids. It also increased the concentrations of blood triglycerides and total protein. These results suggest that the administration of ART EOs impacted positively on milk quality of dairy ewes, however, ROS EOs were ineffective. Further studies would be required to define the mechanism explaining such positive effect.

Keywords. Dairy ewe – Essential oils – Rumen fermentation – Milk.

***Qualité et production du lait chez les brebis de race Sicilo-sarde recevant par voie orale les huiles essentielles d'*Artemisia herba alba *et* Rosmarinus officinalis**

Résumé. *L'objectif de cet essai est d'étudier l'effet de l'administration orale de 200 mg/Kg de MS ingérée d'huiles essentielles (HE) d'*Artemisia herba alba *(ART) et* Rosmarinus officinalis *(ROS) à 30 brebis de race Sicilo-sarde sur la qualité du lait. Les brebis ont été divisées en trois groupes égaux et homogènes sur la base du poids vif, du numéro de lactation et de la taille de la portée. Elles ont été logées dans des boxes individuels. Chaque animal a reçu pendant 60 jours du foin d'avoine et de l'ensilage d'orge* ad libitum *et 500 g de concentré. Le groupe témoin n'a pas reçu d'HE, les deux autres groupes ont reçu respectivement les huiles essentielles de ROS et d'ART. L'ajout des huiles essentielles n'a pas affecté les paramètres de fermentation ruminale chez la brebis, par ailleurs, les brebis qui ont reçu les huiles essentielles d'ART ont montré une augmentation de la densité du lait, de la teneur en matière sèche dégraissée, des protéines totales, des acides gras polyinsaturés et d'autres acides gras. Le même effet a été enregistré au niveau des triglycérides sanguins et des protéines totales. Ces résultats suggèrent que, contrairement aux HE de ROS qui se sont avérées inefficaces, l'administration des HE d'ART présente un impact positif sur la qualité du lait de brebis laitières. D'autres études devraient être envisagées pour identifier le mécanisme expliquant cet effet positif.*

Mots-clés. *Brebis – Huiles essentielles – Fermentation ruminale – Lait.*

I – Introduction

The importance of the milk from sheep and goat to human health, and its added value for household livelihoods have been proven. To improve the quality and production of this commodity many

feed additives has been investigated. Plant derived essential oils (EO) could be used to improve the efficiency of nutrient utilization and performance in ruminants and to reduce the environmental impact of gases generated from feed digestion. The composition and active compounds in EOs vary among plant species thus animal response to the administration of EOs varies accordingly (Benchaar *et al*., 2008). However, literature data on dairy sheep response to the administration of EOs are scarce and the available data are not conclusive (Chaves *et al*., 2008). The objective of the current study was to determine the effects of drenching Sicilo-sarde dairy ewes with EOs extracted from *Rosmarinus officinalis* (ROS) and *Artemisia herba alba* (ART) on rumen fermentation parameters, blood parameters and milk production and composition.

II – Materials and methods

Thirty Sicilo-sarde ewes were randomly selected and divided into three equivalent groups on the basis of live weight, lactation number and litter size. They were housed in individual boxes and received oat hay and barley silage *ad libitum* and 500 g of concentrate (800 g/kg of ground barely, 175 g/kg of soybean meal and 25 g/kg of commercial mineral and vitamin supplement) for 60 days. Essential oils were extracted from *Rosmarinus officinalis* and *Artemisia herba alba* vegetation by hydrodistillation during 6 hours using an apparatus similar to Clevenger (Moyse and Paris, 1967). The compounds in EOs mainly represented by monoterpenes and sesquiterpens, were analysed using a gas chromatograph coupled to a mass spectrometer. The control group (Clt) did not receive EOs, whereas the ART group was drenched daily with 200 mg of EOs/kg DM intake, while the ROS group was drenched with 200 mg of ROS EOs/ kg DM intake. In day 50 about 20 ml of rumen fluid were collected from all ewes before feeding (0h) and after (3h) post-feeding, using a stomach tube. The pH of the rumen fluid was immediately determined, protozoa number were determined using Malassez chamber. Ammonia nitrogen (NH3-N) was analysed according to Weatherburn (1967). Blood samples were withdrawn, on day 46, before feed distribution, plasma was collected after centrifugation and analyzed for glucose, triglycerides, urea and total proteins using Biomaghreb kits. The milk yield of each ewe was recorded daily, individual milk samples, collected weekly, were analyzed for fat, protein, density, salt and lactose by infrared spectroscopy. The chromatographic analyses of fatty acids (FA) were performed using GC/FID. Data corresponding to ewe response to EOs (Tables 1 and 2) were subjected to analysis of variance using the GLM procedure and differences between means were detected using the LSMEANS procedure.

III – Results and discussion

Supplementation with EOs did not affect ($P>0.05$) rumen pH, protozoa count and NH_3-H concentration in the rumen fluid (Table 1). There was a tendency ($P = 0.07$) towards a decrease of NH_3-H at 3h post-feeding for ewes drenched with ART EOs. EOs are rarely reported to affect NH_3-H concentration in vivo with diets similar to those used in the current study (Giannenas *et al*., 2011; Benchaar *et al*., 2008; Tager and Kraus, 2011). However, our findings are in agreement with the *in vitro* results reported by Newbold *et al.* (2004), which observed a decrease in the rate of NH3-N production when rumen contents of cows or sheep supplemented with EO incubated for 24 to 48 h in strained ruminal fluid. Total protein and triglycerides in blood increased by the supplementation of ART EOs. Little information is available on the effect of EOs and their compounds on blood metabolites. Milk yield was not affected by the addition of EOs. This finding is in line with other studies on dairy cattle and cows (Benchaar *et al*., 2007 and 2008, Tager and Kraus 2011). The lack of effect of EO and their active components on milk performance was consistent with the absence of effects of these plant extracts on feed intake and ruminal fermentation.

The composition of milk is given in Table 2. Fat-free dry matter content, density, protein and medium chain fatty acids (MCFA) increased ($P<0.05$) with ART EOs supplementation, but fat tented to

decrease (P = 0.07) and lactose tended to increase (P=0.05). In the contrast, all these parameters were not affected by ROS EOs. These results are in agreement with those of Benchaar *et al*. (2006), who did not note any changes in milk yields, proteins and lactose contents of cows fed up to 2 g/d of EOs. Polyunsaturated fatty acids (PUFA) decreased in ROS ewes, and increased in ART group. Several Gram-positive bacteria are involved in ruminal biohydrogenation of dietary unsaturated FA (Harfoot and Hazlewood, 1988). Therefore, feeding EO could reduce biohydrogenation of FA by reducing the number and the activity of bacteria involved in the biohydrogenation of unsaturated FA. Benchaar *et al.* (2007) concluded that the supplementation of cows with 750 mg of EOs daily had no effect on milk FA profile. However, supplementing the same mixture at a higher dose (2 g/day) increased the proportion of conjugated linoleic acid. The increase of PUFA indicates that ART EOs could be used as a natural additive to improve milk fat nutritional properties for humans.

Table 1. Effects of essential oil supplementation on fermentation parameters and blood metabolites in dairy ewes

	Control	ART	ROS	SEM*	*P*-value
pH					
0h	6.7	6.84	6.73	0.05	0.17
3h	6.46	6.33	6.44	0.05	0.14
Protozoa (x10^5/ml)					
0h	1.18	1.11	1.23	0.13	0.83
3h	0.41	0.43	0.42	0.07	0.98
NH_3-N (mg/dl)					
0h	9.17	10.83	9.44	0.99	0.45
3h	14.5	9.92	12.98	1.38	0.07
Total protein (g/l)	63.44^a	83.37^b	80.30^b	2.91	<0.0001
Triglycerides (mmol/l)	0.12^a	0.22^b	0.12^a	0.02	0.01
Milk production (ml)	369.90	350.45	375	20.05	0.66

ART: *Artemisia herba Alba*, ROS: *Rosmarinus officinalis*, *SEM, standard error of the mean.

Table 2. Milk quality and composition in dairy ewes

	Control	ART	ROS	SEM*	*P*-value
Fat (%)	8.91	7.71	9.04	0.42	0.07
Fat-free dry matter content (%)	8.39^a	9.79^b	8.50^{ab}	0.37	0.03
Density (kg/cm3)	1025^a	1030.85^b	1025.28^a	1.37	0.01
Protein (%)	2.62^a	3.20^b	2.65^a	0.13	0.01
Lactose (%)	4.93	5.63	5	0.2	0.05
Fatty acids					
MCFA	53.24^a	59.20^b	55.87^{ab}	1.3	0.01
LCFA	5.03	6.9	7.02	1.58	0.63
MUFA	11.43	10.35	8.42	1.7	0.45
PUFA	2.50^a	2.74^a	2.05^b	0.18	0.03

ART: *Artemisia herba alba*, ROS: *Rosmarinus officinalis*, *SEM, standard error of the mean.

IV – Conclusion

It is concluded that the administration of ART and ROS EOs at 200 mg/kg DM intake to Sicilosarde ewes did not affect milk yield. However, drenching ewes with ART essential oils increased milk density, fat-free dry matter content, total protein, and PUFA.

Further studies should be emphasized to identify the mechanism explaining such positive effect.

References

Benchaar C., McAllister T.A. and Chouinard P.Y., 2008. Digestion, ruminal fermentation, ciliate protozoal populations, and milk production from dairy cows fed cinnamaldehyde, quebracho condensed tannin, or *Yucca schidigera* saponin extracts. In: *J. Dairy Sci.,* 91, p. 4765-4777.

Benchaar C., Petit H.V., Berthiaume R., Ouellet D.R., Chiquette J. and Chouinard P.Y., 2007. Effects of essential oils on digestion, ruminal fermentation, rumen microbial populations, milk production, and milk composition in dairy cows fed alfalfa silage or corn silage. In: *J. Dairy Sci*., 90, p. 886-897.

Benchaar C., Petit H.V., Berthiaume R., Whyte T.D. and Chouinard P.Y., 2006. Effects of addition of essential oils and monensin premix on digestion, ruminal fermentation, milk production, and milk composition in dairy cows. In: *J. Dairy Sci*., 89, p. 4352-4364.

Chaves A.V., Stanford K., Dugan M.E.R., Gibson L.L., McAllister T.A., Van Herk F. and Benchaar C., 2008. Effects of cinnamaldehyde, garlic and juniper berryessential oils on rumen fermentation, blood metabolites, growth performance, and carcass characteristics of growing lambs. In: *Livest. Sci.*, 117, p. 215-224.

Giannenas I., Skoufos J., Giannakopoulos C., Wiemann M., Gortzi O., Lalas S. and Kyriazakis I., 2011. Effects of essential oils on milk production, milk composition, and rumen microbiota in Chios dairy ewes. In: *J. Dairy Sci*., 94, p. 5569-5577.

Harfoot C.G. and Hazlewood G.P., 1988. Lipid metabolism in the rumen. In: Hobson P.N. (ed.), *The Rumen Microbial Ecosystem*. Elsevier Applied Science Publishers, London, UK, p. 285-322.

Moyse H. and Paris R., 1967. *Matière médicale*, T2, (2e 418 Ed), Masson, Paris.

Newbold C.J., McIntosh F.M., Williams P., Losa R. and Wallace R.J., 2004. Effects of a specific blend of essential oil compounds on rumen fermentation. In: *Anim. Feed Sci. Technol*., 114, p. 105-112.

Tager L.R. and Krause K.M., 2011. Effects of essential oils on rumen fermentation, milk production, and feeding behavior in lactating dairy cows. In: *J. Dairy Sci.,* 94, p. 2455-2464.

Weatherburn M.W., 1967. Phenol hypochlorite reaction for determination of ammonia. In: *Anal. Chem*., 39, p. 971-974.