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Abstract. A lactation study utilizing 72 dairy ewes was performed to determine effects of cold-pressed oilseed cakes (CPOC), including cold-pressed sunflower cake and cold-pressed rapeseed cake, and their interaction with tanniferous sainfoin hay, on production performance and milk fatty acid profile. A 2 x 3 factorial arrangement involving two forages (fescue and sainfoin hay) and 3 experimental concentrates was used. Concentrates were formulated to contain cold-pressed rapeseed cake (RPS), cold-preseed sunflower cake (SUN) or palm (CTR) as fat sources and to provide equal amounts of crude protein fat and energy. SUN reduced milk total saturated fatty acids (SFA) compared to CTR with both non-tanniferous (FES) and tanniferous (SAIN) forages, while RPS only reduced SFA with SAIN. Polyunsaturated fatty acids were increased with SUN and RPS and SAIN. SUN increased n6:n3 ratio compared to CTR (+54%) and RPS (+62%) and SAIN reduced this ratio compared to FES (-27%). Concentrate did not affect milk production. In conclusion, healthier milk can be obtained with CPOCs. Nevertheless the forage used in the ration seems to be of great importance.

Keywords. Tannins – Rapeseed – Sunflower.

La production et le profil d'acide gras du lait affecté par les tourteaux d'oléagineux pressés à froid et le sainfoin

Résumé. *Un essai de lactation a été mené avec 72 brebis laitières au début de l'allaitement dans un arrangement factoriel 2 x 3 impliquant deux fourrages (fétuque et sainfoin) et 3 concentrés expérimentaux. Les concentrés ont été formulés pour contenir tourteau de colza, tournesol ou palme comme sources de graisse, et pour fournir des quantités égales de graisse, de protéines brutes et d'énergie. Le tournesol a réduit les acides gras saturés par rapport au CTR avec des fourrages non tannifères (FES) et tannifères (SAIN), alors que le colza n'a réduit que le SFA avec le SAIN. Les acides gras polyinsaturés ont été augmentés avec SUN et RPS et SAIN. Le tournesol a augmenté le ratio n6: n3 par rapport à CTR (+54%) et RPS (+ 62%) et SAIN a réduit ce rapport par rapport au FES (-27%). Le concentré n'a pas affecté la production laitière. En conclusion, un lait plus sain peut être obtenu avec les CPOC. Néanmoins, le fourrage utilisé dans la ration semble être d'une grande importance.*

Mots-clés. *Tanin – Colza – Tournesol.*

I – Introduction

For over half a century, the concept of healthy eating has been synonymous with reducing fat. A low saturated fat diet remained at the heart of public nutritional recommendation for decreasing low-density lipoprotein, blood cholesterol and lowering the consequent risk of coronary heart disease. Within this context, it is not surprising that sheep milk, containing up to 76% of the total fatty acid (FA) as saturated, has been widely perceived to be detrimental to human health.

Therefore, in these last years a significant research effort has been directed towards modifying milk fat composition in order to increase the concentration of FA with positive effects in human health. In this context, numerous studies have shown that the diet is the most important factor influencing this trait. New ways of supplementary feeding, searching for synergies between feed components, might help to respond to these challenges.

Cold-pressed oilseed cake (CPOC) is a cheap by-product of oil-manufacturing. It is widespread in the European area and it can be obtained on-farm after simple mechanical extraction of the oil from the seeds. CPOC has been shown to have higher crude fat content than those of conventional solvent and expeller meals (up to 230 g kg^{-1} compared to 30 and 100 g kg^{-1}, respectively, Amores *et al*., 2014) which make it an attractive energetic feedstuff for livestock. Sainfoin (*Onobrychis viciifolia*) is a temperate forage legume which has a moderate to high content of condensed tannins (Theodoridou *et al*., 2010). Condensed tannins are known to alter rumen microflora activity, inhibiting the last step of rumen biohydrogenation (Vasta *et al*., 2009).

Therefore, we hypothesize first that feeding ewes on concentrates rich in UFA has an advantage over the typical saturated FA-rich concentrate that contain palm fat, in modifying milk FA profile towards a healthier product. Second, we also hypothesize that tanniferous sainfoin hay may reduce ruminal BH of UFA, modifying to higher degree milk FA profile.

II – Material and methods

The experiment was carried out in accordance with Spanish Royal Decree 53/2013 for the protection of animals used for experimental and other scientific purposes.

1. Animals and experimental diets

The trial was carried out at the Neiker-Tecnalia experiment station. A lactation trial utilized 72 black-faced Latxa dairy ewes at early lactation in a 2 x 3 factorial arrangement involving two forages (fescue and sainfoin hay) and 3 experimental concentrates. Concentrates were formulated to contain cold-pressed rapeseed cake (RPS), cold-preseed sunflower cake (SUN) or palm (CTR) as fat sources. Concentrates were formulated to provide equal amounts of crude protein (CP), energy and fat. Ingredients of experimental concentrates and forages are shown in Table 1.

Table 1. Ingredients and chemical composition (g kg^{-1} DM) of experimental concentrates

Item	Concentrate		
	CTR	SUN	RPS
Ingredients			
Cold pressed rapeseed cake	0	0	400
Cold pressed sunflower cake	0	560	0
Soybean meal	150	0	0
Barley	160	150	360
Corn	180	210	100
Oats	200	0	0
Molasses	50	50	50
DDGs	150	0	60
Hydrogenated palm fat	80	0	0
Vitamin-mineral premix*	30	30	30

CTR: control, SUN: sunflower, RPS: rapeseed, *Vitamin and mineral premix contained per kg of DM: 2500 IU of vitamin A, 400 mg of vitamin D, 2.5 IU of vitamin E, 4.9 mg of Zn, 4.05 mg of Mn and 0.1 mg of Se (Calseaphos, Saint Malo, France).

Ewes were divided into 6 equilibrated groups of 12 ewes each, according to milk yield (2094 ± 520 ml) and days in milk (15 ± 8 d postpartum). The experimental concentrates were offered in individual feeders in the milking parlour as two equal meals (450 g DM) during the morning and evening milkings. Tall fescue (*Festuca arundinacea*) hay or sainfoin hay was group fed *ad libitum* in a feed bunk and water.

2. Measurements and samplings

The experimental period lasted for 56 d, of which the first 7 d were for covariate determinations; the following 7 d were for treatment adaptation to experimental concentrates, and the last 42 d for measurements and samplings. Ewes were milked daily at 0730 and 1800 h, and milk yield was recorded individually 7 d wk^{-1}. On d-18, 25, 31, 40 and 44, an individual sample of milk was taken and stored with potassium bichromate (0.3 g L^{-1}) at 4ºC for fat, protein, and lactose analysis. On d-54, individual milk samples were collected and a composite sample per animal (am and pm milkings) was stored and preserved at -20ºC for FA composition analysis.

3. Statistical analyses

Data (n=72) was analysed using the GLM procedure. The statistical model included fixed effects of CON, FOR, their interaction and the initial record measured at week 0 (covariate). Milk production treatment means were separated using a Tukey test and for milk FA profile Bonferroni adjustment was used.

III – Results and discussion

Mean effects on milk productive performance and fatty acid profile can be seen on Table 2.

Table 2. Mean effects of feeding concentrate and forage on milk productive performance and fatty acid profile

Item	FES			SAIN				P-value		
	CTR	SUN	RPS	CTR	SUN	RPS	SEM	CON	FOR	CONx FOR
Yield (g day^{-1})										
Milk	1911	2085	1998	2300	2413	2421	93.1	0.581	0.001	0.945
6.5% FCM	1794	1763	1865	2109	2200	2025	91.5	0.912	<0.001	0.317
Fat	116	114	122	144	144	131	4.6	0.895	<0.001	0.257
Protein	82	86	90	98	107	101	2.7	0.213	<0.001	0.510
Lactose	98	100	104	115	123	118	3.3	0.572	<0.001	0.682
Milk composition (g kg^{-1})										
Fat	61.6	59.6	61.4	64.4	59.6	57.5	1.11	0.064	0.786	0.140
Protein	42.8	43.7	44.3	43.5	45.5	44.6	0.32	0.006	0.025	0.269
Lactose	51.2	51.1	50.6	51.0	51.8	51.8	0.19	0.413	0.018	0.734
Milk fatty acid profile (g kg-1 FA)										
∑ SFA	664.2^{a}	567.3^{b}	633.3^{a}	715.3^{a}	627.9^{b}	627.8^{b}	25.06	<0.001	<0.001	0.006
∑ MUFA	297.1^{b}	341.5^{a}	314.1^{ab}	233.1^{b}	255.4^{b}	299.0^{a}	22.21	<0.001	<0.001	0.002
∑ c MUFA	260.0	267.3	257.0	187.4^{b}	192.4^{b}	229.5^{a}	20.03	0.066	<0.001	0.010
∑ t MUFA	37.1^{c}	74.2^{a}	57.1^{b}	45.7^{b}	63.0^{ab}	69.4^{a}	9.74	<0.001	0.328	0.013
∑ PUFA	32.6	83.4	44.9	47.5	111.4	68.3	6.95	<0.001	<0.001	0.083
∑ CLA	7.5^{b}	18.7^{a}	9.1^{b}	6.9^{b}	12.1^{a}	10.1^{ab}	2.22	<0.001	0.009	<0.001
n6:n3	2.85	5.99	2.14	1.83	4.10	1.77	0.9035	<0.001	0.001	0.139

CON: concentrate, FOR: forage, CTR: control, SUN: sunflower, RPS: rapeseed, FES: fescue hay, SAIN: sainfoin hay, 6.5%FCM: fat corrected milk, SEM: standard error of the mean.

The lack of detrimental effects on animal production parameters or milk yield due to CPOCs supplementation agrees with other studies (Amores *et al*., 2014). The higher forage eating time concomitant with a reduced rumination time, increased DMI and OMD in animals fed SAIN (Garcia-Rodriguez *et al*., 2017) could have led to increased energy available for microbial protein synthesis and milk production. Higher IGF-1 plasma concentration observed with SAIN (Garcia-Rodriguez *et al*., 2017) agrees with the latter, since protein is a crucial nutritional factor to regulate hepatic IGF-1 expression and secretion (Wan *et al*., 2017) and IGF-1 stimulates milk production (Cohick 1998).

Nutritional strategies that reduce ruminal BH of dietary PUFA and MUFA could be the key to improve milk quality with respect to human requirements. In this sense, the results of this study indicate that the potential of feeding CPOCs for increasing the content of naturally occurring bioactive FA in milk and thus, for enhancing health or reducing the risk of disease, depends on the forage used in the offered diet. In this sense, it could be advisable the use of a tanniferous forage when RPS was fed in order to increase UFA. Previous works have emphasized that tanniferous SAIN exert a general inhibition of biohydrogentation (Toral *et al*., 2016) and focused on the last step, leading to a more unsaturated profile of milk. Our results support this hypothesis when RPS is fed. However, the effect of SAIN impairing biohydrogentation was not easily observed with SUN. In this sense, SUN reduced SFA and increased CLA compared to CTR with both forages. These results suggest that main changes in milk FA profile with a diet supplemented with sunflower oil and tannin extracts were more likely explained by the presence of sunflower oil than by tannins.

IV – Conclusions

In conclusion, healthier milk can be obtained with CPOCs. Nevertheless the forage used in the ration seems to be of great importance.

References

Amores G., Virto M., Nájera A.I., Mandaluniz N., Arranz J., Bustamante M.A., Valdivielso I., Ruiz de Gordoa J.C., García-Rodríguez A., Barron L.J. and de Renobales M., 2014. Rapeseed and sunflower oilcake as supplements for dairy sheep: animal performance and milk fatty acid concentrations. In: *J. Dairy Res.,* 81, p. 410-416.

Cohick W.S., 1998. Role of the insulin-like growth factors and their binding proteins in lactation. In: *J. Dairy Sci.,* 81, p. 1769-1777.

Garcia-Rodriguez A., Goiri I., Pineda-Quiroga, Pascual A., Atxaerandio R. and Ruiz R., 2017. Feeding behaviour, intake, apparent digestibility and plasma metabolites of Latxa dairy ewes as affected by cold-pressed oilseed cakes and sainfoin. In: FA-CIHEAM network on sheep and goats. Joint seminar of the sub-network on production systems & sub-network on nutrition. Accepted.

Theodoridou K., Aufrère J., Andueza D., Pourrat J., Le Morvan A., Stringano E., Mueller-Harvey I. and Baumont R., 2010. Effects of condensed tannins in fresh sainfoin (*Onobrychis viciifolia*) on *in vivo* and *in situ* digestion in sheep. In: *Anim. Feed Sci. Techno. l,* 160, p. 23-38.

Toral P.G., Hervás G., Missaoui H., Andrés S., Giráldez F.J., Jellali S. and Frutos P., 2016. Effects of a tannin-rich legume (*Onobrychis viciifolia*) on *in vitro* ruminal biohydrogenation and fermentation. In: *Span. J. Agric. Res.,* 14, p. 1-9.

Vasta V., Mele M., Serra A., Scerra M., Luciano G., Lanza M. and Priolo A., 2009. Metabolic fate of fatty acids involved in ruminal biohydrogenation in sheep fed concentrate or herbage with or without tannins. In: *J. Anim. Sci.,* 87, p. 2674-2684.

Wan X., Wang S., Xu J, Zhuang L., Xing K., Zhang M., Zhu X., Wang L., Gao P., Xi Q., Sun J., Zhang Y., Li T., Shu G. and Jiang Q., 2017. Dietary protein-induced hepatic IGF-1 secretion mediated by PPARγ activation. In: *PLoS ONE,* 12, p. 1-16.