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The intake and performance of dairy ewes fed with different levels of olive cake silage in late pregnancy and suckling periods

A. Cabiddu*, M. Canu*, M. Decandia*, R. Pompei and G. Molle***
*Istituto Zootecnico e Caseario per la Sardegna,
Strada Sassari-Fertilia km 18,600, 07040 Olmedo, Italy
**Cattedra di Microbiologia, Facoltà di Farmacia, Università di Cagliari,
via Ospedale 72, 09100 Cagliari, Italy

SUMMARY – Five weeks before parturition, 27 Sarda dairy ewes were allotted to 3 groups fed with grass hay, concentrates, and respectively 0 (S0), 250 (S250) and 500 (S500) g of dry matter (DM) per head and per day of crude olive cake silage (OCS). In S250 and S500 grass hay was substituted by OCS in order to have the same level of DM offered to all groups. Treatments were discontinued 5 weeks after lambing. Total intake decreased along with the increase of OCS in the diet ($P < 0.001$): 1691 (S0), 1536 (S250) 1384 g DM (S500). The intake of OCS was on average 168 and 308 g DM in S250 and S500, respectively. The dry matter disappearance (DMD) of the diets was higher in S0 and S250 than S500 and averaged 56.8, 54.5 and 41.6% respectively ($P < 0.001$). The live weight of the ewes decreased more in S250 and S500 than S0 throughout the experiment ($P < 0.01$). Milk production during suckling (measured by the oxytocin method) and milk chemical composition showed no significant effect of treatments. Milk production averaged 1602, 1665 and 1471 ml/head/day, in S0, S250 and S500, respectively. Also lamb daily growth was unaffected by the treatments. In conclusion, despite the drop of intake, ewes' performances were not significantly affected by the substitution of grass hay with OCS.

Key words: Olive cake silage, dairy sheep, digestibility, intake.

RESUME – *"Consommation et performances des brebis laitières en fin de gestation et en allaitement recevant différents niveaux de grignons d'olive ensilés". Cinq semaines avant la mise-bas, 27 brebis de race Sarde ont été réparties en 3 lots alimentés chacun avec du foin de ray-grass, des concentrés et respectivement 0 (S0), 250 (S250) et 500 (S500) g de matière sèche (MS)/tête/jour de grignons d'olive ensilés (OCS). Dans les lots S250 et S500, le foin de ray-grass a été remplacé par l'OCS afin d'avoir le même niveau de MS dans chaque lot. Les traitements ont été appliqués pendant cinq semaines après la mise-bas. L'ingestion totale de la ration diminue avec l'augmentation du niveau de l'ensilage de grignons : 1691 (S0), 1536 (S250) et 1384 g MS (S500), $P < 0,001$. L'ingestion d'ensilage de grignons a été en moyenne de 163 et 310 g MS respectivement pour les lots S250 et S500. Le poids vif des brebis a varié en fonction du type de ration ($P < 0,01$). Des pertes de poids de 3,65, 3,77 et 7,47 kg ont été relevées à la fin de la gestation respectivement pour les lots S0, S250 et S500. Perte de poids respective de 3,65, 6,77 et 7,47 kg en S0, S250 et S500 relevée en fin de gestation. La production laitière (1602, 1665 et 1471 ml/tête/jour S0, S250 et S500) n'est pas influencée par le régime alimentaire. De même, il n'y a pas d'effet significatif du régime alimentaire sur le gain de poids des agneaux. En conclusion, les performances des brebis n'ont pas été influencées par la substitution de foin de ray-grass avec les grignons d'olive ensilés bien que le niveau d'ingestion des brebis soit affecté.*

Mots-clés : *Grignons d'olive ensilés, brebis laitière, digestibilité, ingestion.*

Introduction

From time immemorial man has recycled agricultural by-products through ruminant feeding. In the past the main objective of this practice was to face the poor availability of feedstuffs. Nowadays feeding cost reduction and environmental hazard control are probably also important aims. In the last 20 years many authors have described the use of olive cake (OC, the main by-product from olive oil industry), in animal feeding as air-dried (Manunta *et al*., 1981; Dattilo and Congiu, 1993; Liotta *et al*., 2001; Zumbo *et al*., 2001) ensiled (Nefzaoui, 1991a,b,c; Kayouli *et al*., 1993; Hadjipanayiotou, 1999a,b, 2000) and soda or ammonia-treated feedstuff (Aguilera and Molina, 1986; Amici *et al*., 1991; Molina and Aguilera, 1991). OC is featured by high neutral detergent fibre (NDF) (51.3% dry matter, DM) and acid detergent lignin (ADL) (24% DM) but low crude protein (CP) (5.5% DM). The OC

nutritive value is also very low: from 4.22 (untreated) to 6.46 (alkali-treated) MJ of metabolizable energy (ME)/kg DM (Molina and Aguilera, 1988; Nefzaoui, 1991a). Hadjipanayiotou and Koumas (1996) estimated that untreated OCS worth 3.85 MJ ME/kg of DM. This nutritional value is close to that of straw. In order to verify the feeding value of olive cake silage (OCS), this study was undertaken with the aim of assessing the effect of different levels of OCS in the diet of dairy ewes on their intake and performances during late pregnancy and suckling periods.

Materials and methods

OC was collected in January 1999 the same day of oil extraction (centrifugation method) and was ensiled into a walled silo without any additive. The feeding trial started in October 1999. Twenty-seven Sarda dairy ewes at the end of pregnancy (5 weeks before parturition) and during suckling period (5 weeks after lambing) were used. The ewes [live weight (LW) – mean±SE – 48.46±3.91 kg and body condition score (BCS) 2.68±0.17] were allotted to 3 homogeneous groups, each split into 3 replicates. The groups were fed with ryegrass hay, concentrates, and 0 (S0), 250 (S250) and 500 (S500) g DM/head/day of OCS, respectively. In S250 and S500 ryegrass hay was substituted by OCS in order to have the same level of DM offered to all groups (Table 1). The OCS was mixed with chopped ryegrass hay and offered once daily in the morning. The concentrates were offered in two meals one in the morning and one in the afternoon.

Table 1. Experimental diets offered to late pregnant (pre-lambing) and suckled ewes (post-lambing) including 0 (S0), 250 (S250) and 500 g DM/head/day (S500) of olive cake silage

	Actual offer (g DM/head/day)					
	Pre-lambing†			Post-lambing†		
	S0	S250	S500	S0	S250	S500
Ryegrass hay	1020	795	570	1301	1013	726
Pelleted concentrate	176	176	176	443	443	443
Peas	86	86	86	260	260	260
Olive cake silage	0	225	500	0	288	575
Total	1282	1282	1282	2004	2004	2004

†A transitional diet was offered in the week in which lambings were concentrated.

LW and BCS were measured at the beginning and the end of the experiment. Total fresh matter intake per each replicate was measured daily. Samples of offered and refused feedstuffs were collected daily, bulked across weeks and analysed to determine chemical composition DM, organic matter (OM), CP, ether extract (EE), NDF, acid detergent fibre (ADF), ADL (Martillotti *et al.*, 1987) and *in vitro* DM digestibility (IVDMD; Aufrère and Demarquilly, 1989). Moreover pH, volatile fatty acids (VFA), water soluble carbohydrates (WSC), tannic phenols (TP), NH_3 (Martillotti *et al*., 1987) and acid detergent insoluble nitrogen (ADIN) (Licitra *et al*., 1996) were assessed on silage samples. *In vivo* DM digestibility (DMD) of the three diets (S0, S250 and S500) similar to those given during pre-lambing period was assessed using 9 rams (n = 3 per diet), kept in metabolic cages. Mycotoxin levels on OCS were also checked (HPLC method). EE content in the refusals was used to estimate average OCS intake per replicate. During suckling period, individual milk yield and composition (fat and protein as N*6.38) were measured by oxytocin method (Bencini, 1995). Lamb birth and weaning weights were measured and average daily gains (ADG) consequently calculated. Experimental data with the exception of live weights were analysed by GLM using the diet as fixed effect within period. Lamb weights and lamb ADG were studied by GLM, using the diet and the litter size as fixed effects. Treatment means were separated by *t*-test for multiple comparisons.

Results and discussions

The chemical composition of feedstuffs shows (Table 2) that OCS used in the experiment had high

level of CP and EE and low NDF, ADF and ADL as compared with data from other experiments (Hadjipanayiotou, 1999a,b). The ADIN level in OCS was 12.17 (% CP) whereas WSC and TP were respectively 0 and 0.99 (% DM). The silage showed good aroma and colour with pH of 4.39 and 2.35, 0.10 and 0.26 g/100 g DM of acetic, propionic and butyric acids. Only traces of $N\text{-}NH_3$ were also found. The IVDMD of OCS was 35.2% of DM, higher than previous values reported by Hadjipanayiotou and Koumas (1996) probably due to the lower ADL content in our experiment. As anticipated by relatively good fermentation parameters, B_1, B_2, G_1 and G_2 mycotoxins were not found in OCS.

Table 2. Chemical composition of the feedstuffs

Feedstuff	DM %	CP†	EE†	NDF†	ADF†	ADL†
Ryegrass hay	85.62	11.91	1.61	61.37	34.02	3.00
Pelleted concentrate	89.29	17.07	3.74	38.17	15.13	2.98
Peas	86.79	23.61	1.21	32.14	7.57	0.03
Olive cake silage	52.55	7.14	11.48	64.30	48.11	22.43

†% DM.

The average total intake (Table 3) was negatively affected by OCS level in the diet ($P < 0.001$). No refusal of concentrates was registered whereas the OCS-hay mixture refusal averaged 16 and 28% in S250 and S500, respectively.

Table 3. Total DM intake of ewes receiving diets with 0 (S0), 250 (S250) and 500 g DM/head/day (S500) of olive cake silage. Least square means ± SE

	Group	Pre-lambing	Post-lambing	Total-period
Intake (g DM)	S0	1349 ± 11 a	1869 ± 24 a	1700 ± 28 a
Intake (g DM)	S250	1213 ± 11 b	1688 ± 25 b	1529 ± 29 b
Intake (g DM)	S250	1042 ± 11 c	1583 ± 25 c	1402 ± 29 c

[a,b,c]Different letters within column indicate significant difference ($P < 0.001$).

The OCS intake, as expected, was higher in S500 than S250 (Table 4). The OCS refusal tended to raise during suckling period when the supplementation level was enhanced (see also Table 1).

Table 4. Intake of OCS and its refusal as percentage of the offer in ewes receiving diet with 250 (S250) and 500 g DM/head/day (S500) of olive cake silage. Least square means ± SE

	Pre-lambing		Post-lambing		Total period	
	S250	S500	S250	S500	S250	S500
Intake (g DM)	167 ± 6 a	295 ± 6 b	168 ± 9 a	315 ± 9 b	168 ± 7 a	308 ± 6 b
Refusal (%)	23	32	42	46	36	41

[a,b]Different letters within row and period indicate significant difference ($P < 0.001$).

The DMD of the diets was higher in S0 and S250 than S500 and averaged 56.8, 54.5 and 41.6% respectively ($P < 0.001$). These averages are slightly lower than those found by Hadjipanayiotou and Koumas (1996).

BCS (not shown) decreased in all groups without any effect of dietary treatments. LW showed a reduction higher in the animals fed with OCS: –3.68 (S0) vs –6.68 (S250) and –7.47 kg (S500), $P < 0.01$. Milk yield and milk composition were not affected by feeding regimen (Table 5). The OCS

diet tended (P > 0.1) to reduce milk production only at the highest level of inclusion in the diet (S500). This effect is not in full agreement with results obtained by Hadjipanayiotou (1999b). In that study Chios sheep fed with 370 g DM/head/day of OCS showed a trend towards higher milk yield as compared with control, probably related to a higher level of intake per kg $LW^{0.75}$.

Table 5. Milk yield and milk composition of ewes receiving diet with 0 (S0), 250 (S250) and 500 g DM/head/day (S500) of olive cake silage. Least square means ± SE

	S0	S250	S500
Milk yield (ml/head/day)	1602 ± 413	1665 ± 509	1471 ± 547
Fat (%)	5.8 ± 0.8	6.1 ± 1.1	5.9 ± 1.3
Protein (%)	4.1 ± 0.4	4.1 ± 0.5	3.8 ± 0.3

In Sarda sheep at the end of lactation, a complete diet containing about 300 g DM/head/day of OC resulted in milk yield higher than the control treatment but also in lower milk fat and protein contents (Lanzani *et al*., 1993).

Birth weight, weaning weight and ADG of lambs did not differ significantly between treatments (Table 6). Nevertheless the lambs of the groups supplemented with OCS tended to have a slower daily gain than S0 (P = 0.12).

Table 6. Birth weight, weaning weight and average daily gain of lambs suckling by sheep receiving diets with 0 (S0), 250 (S250) and 500 g DM/head/day (S500) of OCS. Least square means ± SE

	S0	S250	S500
Birth weight (kg)	3.4 ± 0.6	2.9 ± 0.7	3.3 ± 0.5
Weaning weight (kg)	10.5 ± 2.1	9.3 ± 2.0	9.3 ± 1.7
Average daily gain (g)	195 ± 53	178 ± 42	167 ± 49
Total litter gain per ewe (g/ewe/day)	308 ± 23	274 ± 25	291 ± 25

Conclusion

The OC ensiling process has been confirmed to be a simple and low cost technique for OC conservation. Despite the satisfactory result of the ensiling process, the palatability of OCS was low and its inclusion in the diet reduced intake and digestibility of nutrients. Nevertheless, due to sheep capability to buffer medium-term under-nutrition around lambing, ewes' performances were not significantly affected by the substitution of a moderate quality grass hay with OCS, at least up to a level of 250 g DM/head/day. The inclusion of OCS in complete diets based on feedstuffs other than hay, and the implementation of low cost treatments for improving OCS nutritive value deserve further attention. The effect of OCS-based diets should also be evaluated in the light of their impact on the quality of dairy and meat products and hence consumers' acceptability.

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References

Aguilera, J.F. and Molina, E. (1986). Effect of soda treatment on the feeding value of olive cakes. *Ann. Zootech*., 35: 205-318.

Amici, A., Verna, M. and Martillotti, F. (1991). Olive by-products in animal feeding: Improvement and utilization. *Option Méditerranéennes, Series A*, 16: 149-152.

Aufrère, J. and Demarquilly, C. (1989). Predicting organic matter digestibility of forage by the pepsin-cellulase methods. In: *XVI International Grassland Congress*, Nice (France), 4-11 October 1989, pp. 877-878.

Bencini, R. (1995). Use of intramuscular oxytocin injections to measure milk output in non dairy sheep and its effect on milk composition. *Aust. J. Exp. Agr.*, 5: 563-565.

Dattilo, M. and Congiu, F. (1993). The utilization of by-products from the oil industry in the feeding of sheep, for the production of meat. In: *Proc. of the 44th EAAP Annual Meeting*, Copenhagen (Denmark), 16-19 August 1993, Abs. S4.31, pp. 234.

Hadjipanayiotou, M. (1999a). *Voluntary intake of crude olive cake silage by growing ewe lambs, goat kids and Friesian heifers*. Technical Bulletin No. 75. Agricultural Research Institute, Nicosia, Cyprus, 6 pp.

Hadjipanayiotou, M. (1999b). Feeding ensiled crude olive cake to lactating Chios ewes, Damascus goats and Friesian cows. *Livest. Prod. Sci.*, 59: 61-66.

Hadjipanayiotou, M. (2000). The use of crude olive cake silage as small ruminant feed in Cyprus: A review. *Options Méditerranéennes, Series Cahiers*, 52: 51-54.

Hadjipanayiotou, M. and Koumas, A. (1996). *Performance of sheep and goats on olive cake silage*. Technical Bulletin No. 176. Agricultural Research Institute, Nicosia, Cyprus, 10 pp.

Kayouli, C., Demeyer, D. and Accacha, M. (1993). Evaluation of poultry litter and olive cakes as an alternative feed for ruminant production in Tunisia. In: *Proc. of the International Conference on Increasing Livestock Production through Utilization of Local Resources*, Beijing (China), 18-22 October 1993, pp. 420-440.

Lanzani, A., Bondioli, P., Folegatti, L., Fedeli, E., Bontempo, V., Chiofalo, V., Panichi, G. and Dell'Orto, V. (1993). Integrated olive husks applied to the milk sheep feeding influences on the quali-quantitative production of milk. *La Rivista Italiana delle Sostanze Grasse*, LXX: 375-383.

Licitra, G., Hernandez, T.M. and van Soest, P.J. (1996). Standardization of procedures for nitrogen fractionation of ruminant feeds. *Anim. Feed Sci. Tech.*, 57: 347-358.

Liotta, L., Chiofalo, B., Bella, M. and Chiofalo, L. (2001). Use of vitamin E in lambs fed olive cake: Effects on intramuscular fat fatty acids. In: *Proc. of the XIV Congress of ASPA*, Firenze (Italy), 12-15 June 2001, pp. 559-561.

Manunta, G., Floris, B. and Pettinau, M. (1981). The influence of a diet containing olive cake on the level of fatty acid in sheep milk. In: *Proc. of IV Congress of SIPAOC*, Sassari (Italy), 22-24 October 1981, pp. 163-168.

Martillotti, F., Antongiovanni, L., Rizzi, L., Santi, E. and Bittante, G. (1987). *Metodi di Analisi per la Valutazione degli Alimenti di Impiego Zootecnico*. Quaderni Metodologici, No. 8. CNR-IPRA, Roma.

Molina, E. and Aguilera, J.F. (1988). Nutritive value of a soda-treated olive cakes. Digestibility of cell wall components. *Ann. Zootech.*, 37(2): 63-72.

Molina, E. and Aguilera, J.F. (1991). Olive by-products utilization in sheep feeding. *Options Méditerranéennes, Series A*, 16: 163-166.

Nefzaoui, A. (1991a). Valorisation des sous-produits de l'olivier. *Options Méditerranéennes, Series A*, 16: 101-109.

Nefzaoui, A. (1991b). Valeur nutritive des ensilages combinés de fientes de volailles et de grignons d'olive. 1. Influence de la durée d'accumulation des fientes et des proportions respectives de fientes et de grignons sur la composition chimique et les caractéristiques fermentaires des ensilages. *Ann. Zootech.*, 40: 105-111.

Nefzaoui, A. (1991c). Valeur nutritive des ensilages combinés de fientes de volailles et de grignons d'olive. 2. Quantités ingérées, digestibilités, rétentions azotées et transit des particules chez les ovins. *Ann. Zootech.*, 40: 113-123.

Zumbo, A., Chiofalo, V., Lanza, M. and Dugo, P. (2001). Effect of vitamin E in lambs fed olive cake: Chemical composition of meat and lipid oxidation. In: *Proc. of the XIV Congress of ASPA*, Firenze (Italy), 12-15 June 2001, pp. 556-558.