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in

Ledin I. (ed.), Morand-Fehr P. (ed.).
Sheep and goat nutrition: Intake, digestion, quality of products and rangelands

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 52

2000
pages 51-54

The use of crude olive cake silage as small ruminant feed in Cyprus: A review

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SUMMARY – This article is a review of research and field trials undertaken in Cyprus from 1993 to 1997 with the objective of evaluating the nutritive value of crude olive cake (COC), the by-product remaining after the extraction of olive oil from olives, in ruminant animal feeding. Ensiling of COC either alone or with other agro-industrial by-products and animal wastes resulted in an extended storage of COC in very good condition. The ensiled by-product, which contained around 10.5% oil (DM basis) was very palatable. When it comprised 15-20% of the whole diet given to growing or lactating ruminants it had a nutritional value ranging from that of barley straw up to that of good quality hay. Ensiled COC was also used for making good quality urea blocks. Based on the experience gained from the present studies it can be concluded that the ensiling technique can be used for long storage of COC, and that ensiled COC can partially replace conventional roughages in diets of mature dry, growing and lactating ruminants. Finally, based on its nutritional worth, and the current monetary value for barley grain, soybean meal and conventional roughages, ensiled COC may obtain a monetary value when fed to ruminants that is much higher than its current price of US $ 6-10/t on the farm.

Key words: Crude olive cake, ensiling, dairy ewes, dairy goats, nutritive value.

RESUME – *"Utilisation d'ensilage de grignons d'olive entière comme aliment pour petits ruminants à Chypre : Une revue". Cet article est une revue sur la recherche et les essais de terrain entrepris à Chypre entre 1993 et 1997 avec l'objectif d'évaluer la valeur nutritive des grignons d'olive entière (GOE), sous-produit issu de l'extraction d'huile à partir d'olives, en alimentation du ruminant. L'ensilage de GOE soit seul, soit mélangé à d'autres sous-produits industriels ou déchets animaux, permet un stockage du produit dans des conditions très satisfaisantes. Le sous-produit ensilé contient environ 10,5% d'huile sur la base de la matière sèche et est très appétent. Quand il est incorporé dans le régime à 15-20% pour des ruminants en croissance ou en lactation, sa valeur nutritive se situe entre une paille d'orge et un foin de bonne qualité. Le GOE ensilé est aussi utilisé dans la fabrication de blocs d'urée de bonne qualité. A partir de l'expérience accumulée par les études réalisées récemment, on peut conclure que la technique d'ensilage peut être utilisée pour un stockage long de GOE et que cet ensilage peut en partie remplacer les fourrages conventionnels dans les régimes des ruminants en croissance, en lactation ou en période sèche. En définitive, compte tenu de sa valeur nutritionnelle et du prix moyen de l'orge, du tourteau de soja et des fourrages conventionnelles, le GOE ensilé a une valeur marchande quand il est destiné à l'alimentation des ruminants, à un prix moyen nettement supérieure à 6-10 US $/t (départ ferme).*

Mots-clés : *Grignons d'olive entière, ensilage, brebis laitière, chèvre laitière, valeur nutritive.*

Introduction

Crude olive cake (COC), a mixture of skins, pulp, woody endocarp and seeds obtained after the extraction of oil from olives, is one of the agro-industrial by-products that is available in appreciable quantities in most Mediterranean countries (Sansoucy, 1987), comprising 35% by weight of the olives processed for oil extraction.

Despite the fact that COC is partly used for the extraction of seed oil with the use of solvents, in remote areas within countries it is offered fresh to animals. Fresh COC, however, can only be partly utilised because it is seasonally available, and becomes rancid and mouldy quickly due to its high oil [around 10.5% ether extract, dry matter (DM) basis] and moisture (50-70%) content. It was noted in our early studies that voluntary intake of COC was greatly reduced with advancing storage in uncovered heaps, and our first efforts were concentrated on the testing of simple, safe and low cost techniques for extended storage of COC, and its subsequent use in balanced ruminant animal rations.

The composition (g/kg DM) of COC used in the present studies is included in Table 1.

Table 1 Composition of COC (g/kg DM)

DM	CP	Ash	EE	CFi	NDF	ADF	ADL	Total sugars
495	55	20	102	458	729	513	240	6

Ensiling studies

In our early efforts fresh COC was ensiled in small scale laboratory silos alone or with other materials, molasses, ground grain maize, screened poultry litter. Taking into consideration the pH, aroma, colour and the concentration of lactic, acetic and propionic acids in the silages, it was concluded that good quality silage can be made even from plain COC (Hadjipanayiotou, 1994). Following the ensiling in small laboratory silos, silages of plain COC and combination of COC with poultry litter and ground corn grain (70:20:10) were made on a large scale for use in the animal studies described in the present paper. The methodology of COC silage making was outlined by Hadjipanayiotou (1999).

Use of ensiled COC as part urea blocks (UB): Urea blocks have been considered as an ideal mode for supplementation because of the convenience in transportation, storage and particularly ease of application by the farmers (Sansoucy, 1986). The fact that COC is available during the rainy season, make its use for urea block manufacturing problematic, since sun-drying of COC and dehydration of blocks is very difficult. UB that were sufficiently hard and compact were made (Hadjipanayiotou, 1996) from mid-spring to early autumn using 0, 10, 20, 30, 40, 50, 75% of ensiled COC. COC seemed to have binding qualities, and at high levels of inclusion (≥15%) may reduce the quantities of binders needed.

Animal studies

Growing ruminants: Growing Chios ewelambs and Damascus goatkids were divided into two uniform groups based on their LWT and age. The two groups were randomly allocated to either the control (C) or the silage (S) group.

Animals in the C group were offered conventional feedstuffs (concentrate mixture 160 g CP/kg DM and barley hay, approx. ratio 0.65:0.35) whereas animals of the S group were given 70 percent of the allowance given to the animals on the C group plus silage *ad libitum*. Silages used were either made of COC, ground maize grain and poultry litter (S_1) (7:1:2) or plain COC (S_2). The chemical composition (g/kg DM) and other characteristics of the two silages is included in Table 2.

Table 2. Chemical compositon (g/kg DM) and other characteristics of the two silages

Silage	DM	CP	Ash	EE	*in vitro* Dig.	pH
S_1	505	128	55	80	258	4.8
S_2	490	63	28	113	115	4.6

The voluntary intake of COC silage and the performance of growing kids and lambs are shown in Table 3. With the exception of the trial with ewelambs where animals on the C group were loosing weight as opposed to weight gain of those on the S group, in all other trials with growing goatkids and ewelambs there was no difference in LWT gain between animals on the C or the S diets.

Taking into consideration the energy intake from conventional feedstuffs and the energy in LWT gain in the two groups the estimated energy value of COC silage was equal to 5.5-7.0 MJ ME per kg DM.

Voluntary intake study: Chios ewelambs and Damascus goatkids were used to measure animal species differences in voluntary intake of COC silage. Animals were offered 32 g/kg $W^{0.75}$ of concentrate

and 16 g/kg $W^{0.75}$ of barley hay plus silage *ad libitum*. Although the difference between lambs and kids did not reach significance (lambs 34 g/kg $W^{0.75}$, kids 28 g/kg $W^{0.75}$), the fact that voluntary silage intake was lower in kids than lambs during the first 3 weeks (26%, 19% and 58% of that of lambs in weeks 1, 2 and 3, respectively) on test, supports the assumption that goatkids require longer adaptation period than ewelambs to a new feed.

Table 3. Performance of growing Chios ewelambs and Damascus goatkids offered a conventional diet (C) or one with partial replacement (30%) by silage

	Ewelambs			Goatkids			Ewelambs			Goatkids		
Treatment	C	S_1	SE	C	S_1	SE	C	S_2	SD	C	S_2	SD
No. of animals	15	15	–	10	10	–	15	16	–	11	12	–
Initial weight (kg)	42.6	42.7	1.40	34.5	34.5	0.98	43.5	43.5	3.82	34.1	33.7	4.58
Final weight (kg)	41.6	44.7	1.53	36.5	36.2	1.30	47.3	46.9	4.14	38.2	36.8	4.76
Weight change (g/d)	–27	53	16	46	39	11	61	54	33	66	50	21
Feed Intake (g/animal/d)												
Concentrate	580	410	–	660	460	–	700	490	–	600	430	–
Barley hay	310	220	–	350	250	–	380	270	–	320	230	–
Silage (fresh)	–	1457	–	–	787	–	–	1320	–	–	870	–
Silage (DM)	–	733	–	–	377	–	–	650	–	–	430	–

Lactating animals: Two trials (48 Chios ewes, 48 Damascus goats) were carried out to study the effect of partial replacement of barley hay with plain COC silage (S group) on the lactation performance of ewes and goats. Animals within trial were stratified based on their individual milk yield and allocated to the two treatments (C vs S) at random.

Intakes by ewes and goats on the two diets is shown in Table 4. There was no difference between diets in absolute milk yield and fat corrected milk yield of ewes and goats. Ewes on diet S produced milk of higher ($P < 0.01$) fat content, but in goats the difference was not significant. There was no difference between diets in weight changes in ewes, but goats on diet S lost more ($P < 0.01$) weight than those on diet C.

Table 4. The effect of partial replacement of conventional roughage (C) with an olive cake silage (S) on the performance of lactating Chios ewes and Damascus goats

Trial	Ewes			Goats		
Treatment	C	S	SD	C	S	SD
No. of animals	23	23	–	24	24	
Milk yield (kg/d)	2.05	2.12	0.38^{NS}	2.10	2.05	0.42^{NS}
Fat corrected milk† (kg/d)	1.84	2.00	0.37 P = 0.1	2.07	2.13	0.40^{NS}
Fat (g/kg)	48.2	54.0	5.62 P < 0.01	39.8	42.9	4.9 P = 0.1
CP (g/kg)	–	–	–	39.1	38.6	3.3^{NS}
Weight gain (g/d)	88.0	79.0	103^{NS}	7.0	–31	50 P = <
Feed intake (kg/animal/d)						
Concentrate	1.9	1.9	–	1.71	1.71	–
Barley hay	0.80	0.44	–	0.77	0.35	–
Silage (fresh, 49%	–	0.75	–	–	0.79	–
Silage (DM)	–	0.37	–	–	0.39	–

†Ewes 6%, goats 4%.

Conclusions and recommendations

It can be concluded that the ensiling technique can be used for long storage of COC. COC can partially replace conventional roughages in diets of growing and lactating ruminants. Based on its nutritional worth, and the current monetary value (US $/t) for barley grain $ 118, soybean meal $ 323 and conventional roughages $ 95, ensiled COC has a value of $ 57/t when fed to ruminants. This is much higher than its current price of US $ 6-10/t. Ensiled COC can be used in the manufacture of urea blocks where has the effect of improving block quality.

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