Olive Oil Cake as Animal Feed
B. Use of Olive Oil Cake Supplemented with Urea in the Rations of Growing Barbary Lambs

M. A. RAZZAQUE, A. M. ABOAYSHA AND F. E. OMAR[1]

ABSTRACT

Olive Oil Cake (OOC) was analysed for macro and micro minerals and was found to contain sufficient quantities of K, Cu, Mn and Zn to meet the daily requirements of sheep when fed at the experimental level.

In feeding and growth trials OOC was used to replace the commercial concentrate (14% crude protein) of Barbary lambs on a dry matter basis at the rates: commercial concentrate without OOC (control), 15% OOC, 25% OOC and 50% OOC in rations 1, 2, 3 and 4, respectively. Urea was added to rations 2, 3 and 4 to make them isonitrogenous with the control ration at 14% crude protein (CP) level. Each ration was then fed to one group of lambs for a period of 8 weeks. Oat hay was used as the roughage part of the diet. Growth performance of lambs, dressing percentages and carcass quality were evaluated.

There were no significant differences in performance and dressing percentages between groups. Lambs fed the highest OOC level had the lowest feed conversion efficiency of dry matter and protein. Carcasses of lambs fed OOC rations contained more subcutaneous and peritoneal fat than the control.

It is concluded that OOC is a potential semi-bulky or bulky feed for lambs and it can successfully substitute up to 25% of the commercial concentrate when the ration is supplemented with urea.

INTRODUCTION

In Libya an amount of 85,000 tons of OOC was produced in the year 1976 (9). However, there is a little available information on the feeding value of OOC in sheep rations. This is possibly due to the lack of detailed chemical analysis of OOC and data concerning its nutritive value.

Its use in feeding livestock has received little attention, despite the scarcity of bulky feeds for ruminant animals. FAO reports (3) indicated that the composition of OOC

[1]*Department of Animal Production, Faculty of Agriculture, University of Al-Fateh, Tripoli, S.P.L.A.J.*

varies appreciably due to the different methods used in the processing of olives with oil content being the most variable component. Due to the high fat and fibre content of OOC, it is expected that ration digestibility and utilization by lambs will be reduced (5, 6, 7, 8). Since olives are known to contain oleorupein, a bitter substance (4), palatability and feeding value of OOC rations are uncertain. However, feeding trials (1, 12) indicated that this by-product could substitute considerable proportions of the concentrate dry matter for sheep and heifers.

This experiment was conducted to study the mineral composition of OOC and to evaluate the performance of Barbary lambs when OOC was incorporated in their rations together with added urea as a nitrogen supplement.

MATERIALS AND METHODS

Mineral composition of OOC

Samples of OOC were obtained from local factories and dried prior to analysis. The whole OOC was separated by screening and the pulp and seed analysed separately for Ca, P, Mg, Na, K, Cu, Mn and Zn by the AOAC (1965) methods (2).

Rations

OOC (coarse mesh, expeller processed) was used to replace part of the commercial concentrate (14% CP) of growing Barbary lambs at the rates of 0% (control), 15%, 25% and 50% on DM basis in rations 1, 2, 3 and 4, respectively (Table 1). Because of the diluting effect of OOC on the crude protein concentration, urea was added at the rates of 0.5, 0.9 and 1.7 percent in rations 2, 3 and 4, respectively, to make them isonitrogenous with the control ration at 14% CP. Oat hay was fed to all lambs as a basal diet. Both concentrate and hay allowances were adjusted periodically. The chemical analysis of all rations was carried out according to the AOAC (1965) methods (2).

Table 1. The mineral composition of olive oil cake (OOC)-g/kg DM.

Mineral	Seed	Pulp	Whole
Calcium	3.3	7.0	5.1
Phosphorus	0.4	0.3	0.8
Magnesium	0.4	1.0	0.7
Sodium	0.5	0.6	0.6
Potassium	5.9	11.1	8.5
Copper	0.007	0.021	0.014
Manganese	0.065	0.093	0.079
Zinc	0.009	0.032	0.020

Animals

A total of 40, 4–5 months old Barbary lambs of comparable weight were divided at random into 4 groups, A, B, C and D. Each group contained 5 males and 5 females.

Feeding and management

All groups of lambs were allotted at random to treatments and allowed 2 weeks to adjust to their rations. Feed requirements were estimated according to the NRC (1975), standards. Each lamb received 250 to 400 grams of concentrate daily which was adjusted at weekly intervals. Oat hay was fed to all groups *ad libitum* for an eight week experimental period. The concentrate was fed daily in the morning at 9 a.m. and the hay was fed daily at 4 p.m. Water and salt blocks were available *ad libitum*. Feed refusals were collected and weighed weekly. All animals were weighed at the start of the experiment and thereafter at weekly intervals.

Carcass quality

At the end of the experimental period two lambs from each group (one male and one female) selected at random, were slaughtered. The dressing percentages and general features of the carcasses were recorded.

Statistical analysis

For statistical analysis of results, analysis of variance (Snedecore, 1957) and Dancan's new multiple range test (Duncan, 1955) were conducted (13).

RESULTS AND DISCUSSION

Mineral composition of OOC

The mineral composition of OOC is given in Table 1 and the components of the experimental rations are given in Table 2. Although OOC is a poor source of protein it is rich in certain minerals, especially K, Cu, Mn and Zn. The pulp contained 2–3 times as much of these minerals as the seed.

The proximate composition of OOC was discussed in a previous paper (12). In the

Table 2. The experimental rations and their chemical composition*.

	Experimental rations % on DM basis			
	A	B	C	D
Feeds				
Commercial concentrate	100	84	73.3	48.5
Olive oil cake (OOC)	0	15	25.1	49.5
Urea	0	0.5	0.9	1.7
Salt	0	0.5	0.5	0.5
Chemical composition (% on DM)				
Crude protein	14.10	14.11	14.42	14.60
Ether extract	2.50	4.20	5.50	8.20
Crude fibre	13.60	14.42	15.57	17.55
Ash	9.10	8.87	8.73	8.44
Nitrogen free-extract	60.70	58.48	55.78	48.79

*Oat hay was fed to all lambs *ad lib*. It contained 5.3, 25.0, 1.8 and 5.2 percent of crude protein, crude fibre, either extract and ash, respectively.

present study, the mineral composition of whole OOC was related to the requirements of cattle and sheep and it was found that OOC contained sufficient quantities of minerals to meet their requirement with the exception of P. The findings that the pulp contains more nutrients than the seeds would suggest the introduction of new techniques for separating these two fractions. The aim being to make the pulp fraction available for animal feeding in Libya.

Live weight gain, feed efficiency and dressing percentage

The findings of the present study indicated that, although there were obvious differences in live weight gains (Table 3), feed efficiency (Table 4) and dressing percentages (Table 5) between groups of lambs, these differences were not significant. Live weight gains (Figure 1) are higher in the lambs which received ration 2 (15% OOC) than in other groups. Male lambs were more efficient than female lambs in converting dietary dry matter and protein to live weight. Lambs fed the higher OOC levels in their rations (50%) had the lowest feed efficiency. Dressing percentages of the lambs in the different groups varied from 37.7 to 40.2% (Table 5). Carcasses of lambs which received the commercial concentrate had $1\frac{1}{2}$ to 2 units higher in dressing percentage than the lambs which received OOC in their rations.

Table 3. Live weight daily gains (g) of the experimental lambs*.

Groups	Males	Females	Overall average (Males + Females)
A (Control)	139.7 ± 13.9	90.9 ± 10.5	114.8 ± 11.6
B (15% OOC)	141.9 ± 11.2	117.5 ± 22.6	129.7 ± 13.1
C (25% OOC)	119.2 ± 20.5	115.5 ± 20.2	117.3 ± 13.3
D (50% OOC)	99.6 ± 19.8	74.4 ± 14.2	87.0 ± 12.2

* Mean ± SE

Table 4. Dry matter (DM) and crude protein (CP) required per kg weight gain and treatment differences in fat consumption.

Rations	Male		Female		Male and female		Male and female
	DM	CP	DM	CP	DM	CP	Fat/kg feed consumed
	(Kg)	(g)	(Kg)	(g)	(Kg)	(g)	(g)
A (Control)	6.9	760	10.7	1179	8.8	970	23
B (15% OOC)	7.1	778	8.5	933	7.8	856	27
C (25% OOC)	9.0	871	8.1	901	8.5	886	34
D (50% OOC)	9.2	984	12.3	1320	10.7	1152	44

The findings obtained in this study are in agreement with earlier studies (1), which did not reveal any significant differences in daily gains of sheep when OOC was fed at 30% level in their concentrate mixture. OOC differs in fat content due to the different methods of processing. In Libya the expeller method is used to process olives. This results in the production of OOC of high fat content (14%). Ration palatability was not

Table 5. Dressing percentages (Mean+SE) and degrees of fat deposition.

Group	Dressing percentage	Peritoneal fat	Carcass
A (Control)	40.20±0.54	Moderate	Lean
B (15% OOC)	37.50±1.20	Moderate	Slightly fatty
C (25% OOC)	38.80±1.45	Fatty	Fatty
D (50% OOC)	37.70±1.05	Very fatty	Very fatty

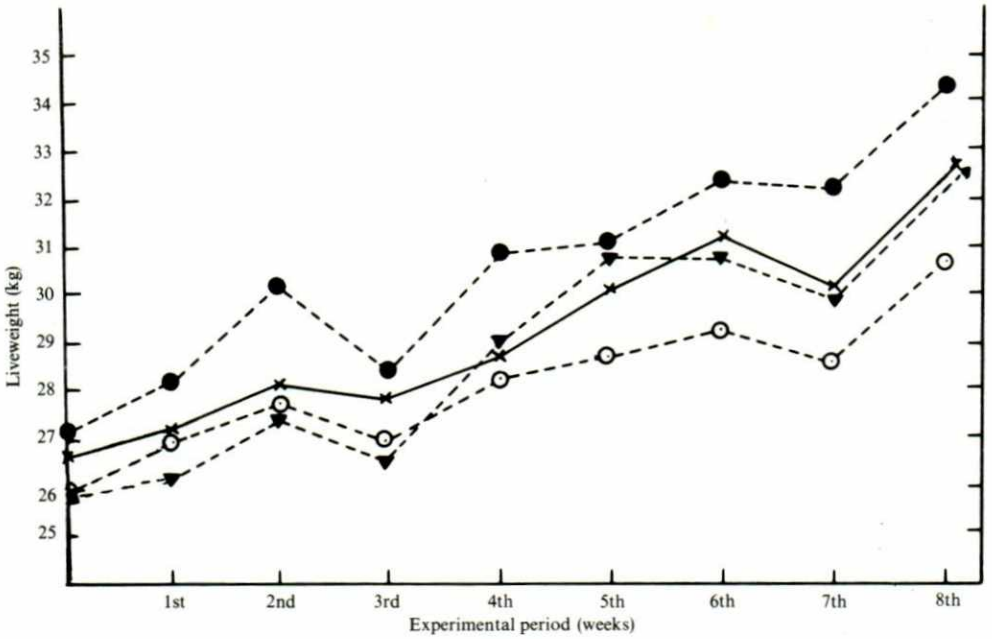

Fig. 1. Growth curve of 4 groups of lambs (mean weight of 10 lambs, 5 males and 5 females in each group) fed the 4 experimental diets. Group A as control (x————x) fed the commercial concentrate without OOC. The other 3 groups were fed the control ration containing OOC at the rate of 15% in group B ●————●, 25% in group C △————△ and 50% in group D ○————○.

affected by the addition of as much as 50% OOC. This is in agreement with previous findings with dairy heifers (12). Palatability was not reduced even though OOC is known to contain some bitter substances (4). The addition of OOC to the concentrate mixtures caused an increase in the fat and fibre percentages and reduced CP and soluble carbohydrates. The reduction in N percentage was compensated by the addition of urea. The differences in the fat and fibre content of rations is expected to affect digestibility and feed utilization by the lambs. The reduction in digestibility of organic matter and protein of OOC containing mixtures has been reported by other researchers (1). Some studies reported a higher reduction in the activity of the rumen microflora (40–50%) when OOC was incorporated in sheep rations. Ration B promoted a better growth rate, feed efficiency and dressing percentage when compared with the control. This could be attributed to urea since it is 'actively hydrolyzed to ammonia in the presence of available carbohydrates' (10) and is 'efficiently utilized by

ruminants if the ration is deficient in protein and the diet contains sufficient soluble carbohydrates' (11). The low level of gain in body weights, feed conversion efficiency and dressing percentage observed in the lambs fed high OOC levels could be attributed to the high fat content of the ration which has an adverse effect on digestibility (5). A 40% depression of organic matter digestibility was reported in lambs when the ration was supplemented with vegetable oil at the rate of 40 g/kg of feed (6). In this study the fat content of rations 1, 2, 3 and 4 were 23, 27, 34 and 44 g/kg feed, respectively. Approximately two thirds of the total dietary fat in ration 4 was derived from OOC. The findings that dry matter and protein intake per kg body weight gain were higher with rations containing high percentages of OOC, especially at the 50% OOC level (Table 4). These results are in agreement with other studies, which reported a significant reduction in voluntary feed intake, cellulose digestion and changes in the pattern of VFA production in the rumen of sheep fed high fat rations (7).

Carcass quality

Lambs which received OOC in their rations had more subcutaneous and peritoneal fat. Fat deposition under the skin, peritoneal cavity, around the heart and kidneys was more pronounced among lambs fed the higher levels of OOC (Table 5). Olive oil contains 65–68% oleic acid and 5–15% linoleic acid (4). If these unsaturated fatty acids escape biohydrogenation in the rumen, this could explain the observation that the fat deposited in these sites was of a soft consistency.

The results of the present study suggest that OOC is a potential semi-bulky or bulky feed for lambs and it can successfully substitute up to 25% of the commercial concentrate when the ration is supplemented with urea.

A new series of experiments are currently under way in Libya aimed at testing the nutritive value of these new products: (a) solvent extracted OOC, and (b) the pulp fraction of olive seed.

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كسب بذرة الزيتون (الفيتورا) كعلف للحيوان
ب . استعمال كسب بذرة الزيتون مضافاً إليه اليوريـا
في علائق حملان أغنـام البربـري

م . أ . رزاق ع . م . أبو عائشـة ف . الشيخ عمـر

لقد تم تحليل كسب بذرة الزيتون لتعيين محتواها من العناصر المعدنية الكبيرة والنادرة ، وقد وجد بأنها تحتوي على كميات كافية من البوتاسيوم، النحاس،المنجنيز والزنك تفي بالإحتياجات اليومية للأغنام والأبقار إذا ما تم استعمالها في علائق الحيوان بالمستوى الذي اتّبع في هذه التجربة .

هذا وقد تم إحلال كسب بذرة الزيتون محل صفر ، ١٥ ، ٢٥ ، و٥٠٪ من المادة الجافة للعليقة المركزة للأغنام ، وأضيفت اليوريا لعلائق ٢ ، ٣ و٤ لجعل العلائق متساوية في نسبة البروتين الخام (١٤٪ بروتين خام) كما تم تقديم خرطان الشوفان كعلف خشن للحملان طيلة مدة التجربة وكانت ٨ أسابيع وفي نهاية التجربة تم تعيين وتقييم نمو الحملان ، نسبة التصافي وكذلك جودة الذبيحة .

وقد اتضح من النتائج أنه لا يوجد فروق معنوية فيما يخص الزيادة اليومية للوزن وكذلك نسبة التصافي بين مختلف المجموعات ، إلا أن الحملان الذين احتوت العليقة المركزة المقدمة لهم على أعلى مستوى من كسب بذرة الزيتون كانت كفاءتهم الغذائية الأقل .

ويمكن الإستخلاص بأن كسب بذرة الزيتون يمكن إحلالها محل ٢٥٪ من المادة الجافة للعليقة المركزة للأغنام عند استعمال اليوريا كمادة إضافية .