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Olive Oil Cake as Animal Feed
A. Use of Olive Oil Cake in the Rations of Growing Heifers

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ABSTRACT

Olive oil cake (OOC) was used to replace the concentrate mixture offered to Holstein Friesian heifers. Replacement was made on dry matter basis at the rate of 0, 25, and 50% OOC of the commercial concentrate mixture in ration 1, 2, and 3, respectively, using 9 heifers, divided equally into 3 groups. Each group received one of the rations for a 33 day experimental period (phase 1). Using the same group of animals, supplemental urea was added to rations 2 and 3 to make them isonitrogenous (16% CP), and fed for a 36 day experimental period (phase 2).

The experiment was conducted to observe the effect of substitution of OOC for the commercial concentrate mixture, on palatability and its effect on growth performances and feeding costs of yearling heifers.

It was observed that control animals (ration 1) performed better in respect of weight gain as compared to gain of animals receiving either rations 2 or 3. However, these differences were not statistically significant. Urea addition (phase 2) resulted in an improvement of the animal performances specially at the 50% OOC level.

Both rations 2 and 3 were palatable to heifers during total feeding period (phase 1 and 2). When costs of feeds were compared (phase 2), it was found that the cost per kg weight gain of heifers receiving 50% OOC ration was lower than either the control group or the group receiving the 25% OOC.

INTRODUCTION

Olive oil cake is an industrial by-product obtained from olive oil processing factories in countries of the Mediterranean zone. Libya produces substantial quantities of olive oil cake. A recent survey (8) indicated that OOC production has increased considerably in Libya during the last 5 years due to increased plantation of olive trees. In Libya an amount of 85,000 tons of OOC was produced in the year 1976. Information regarding the usefulness of OOC as animal feed appears to be scanty. Maymone *et al.* (7) indicated limited values of olive by-products for animals. FAO reports (3) indicated that composition of OOC varies appreciably due to differences in methods used in processing of olives. The most variable component appears to be fat. Recent work (9) indicates that OOC contains useful nutrients to be considered as one of the ingredients of ruminants' diet. But, since olive oil is known to contain oleorupein, a bitter substance (4); palatability of this product to animals is uncertain. In an

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attempt to evaluate OOC as animal feed, an experiment was conducted to study palatability of OOC and its effects on growth performances of yearling heifers when added to the rations with or without supplemental urea.

MATERIALS AND METHODS

Feeding and growth trials

Initially 4 yearling Holstein Friesian heifers were placed on rations with different levels of commercial mesh and olive oil cake to observe the acceptable level of OOC by the animal. The preliminary trials indicated that OOC could be incorporated in the commercial concentrate up to 50% on a dry matter basis. At the end of this preliminary observation, feeding and growth trials were conducted with yearling Holstein Friesian heifers weighing 120–160 kg. The trial was conducted in two phases.

First phase: Nine heifers as described above were divided equally into 3 groups and assigned at random to 3 different rations. The dry matter of the commercial concentrate mixture (16% CP) was replaced by dry matter of OOC at the rate of 0, 25 and 50% in the ration 1, 2 and 3, respectively. The OOC used in this experiment contain 6.37% crude protein dry matter. Therefore, it had a diluting effect on the crude protein level of rations 2 and 3 (Tables 1 and 2).

Table 1 Proximate components of different fractions of olive oil cake (g/kg DM).

Proximate component	Seed	Pulp	Whole olive oil cake
Crude protein	35.7	91.8	63.7
Crude fibre	272.3	173.6	222.9
Ether extract	75.8	214.9	145.3
Ash	34.1	130.1	82.2
Nitrogen-free extract	582.1	389.6	486.0

Table 2 Composition of experimental concentrate mixtures (% on DM) of first feeding trial.

Ration	Mixture	CP	CF	EE	Ash	NFE
1	100% commercial concentrate	16.00	7.0	2.0	8.0	67.0
2	75% commercial concentrate + 25% OOC	13.6	10.8	5.1	8.1	62.4
3	50% commercial concentrate + 50% OOC	11.20	14.6	8.2	8.1	57.7

Table 3 Composition of the hay (% on DM)

CP	5.90
CF	26.0
EE	2.0
Ash	5.70

During the first trial animals were adjusted to the experimental rations for 2 weeks which was followed by a 33 day growth trial. The animals were fed individually 4.5 kg concentrate mixture and 2 kg oat hay daily (Table 3).

Second phase: At the end of first phase the experimental rations were adjusted for crude protein level. The animals of the first phase were used in the second phase. Urea was added to rations 2 and 3 to make them isonitrogenous (16% CP). Two weeks adjustment period was followed by a 36 day growth trial. During this trial each animal received 5 kg OOC containing mixture plus 2.5 kg oat hay daily.

During both trials the entire rations were fed twice daily at 9 a.m. and 3 p.m. Water was available *ad libitum*. The weight gain of the animals was recorded once a week.

Analytical methods

The basal concentrate mixture, OOC-containing rations and the oat hay were analysed for crude protein (N × 6.25), crude fibre, ether extract, and ash by the method of AOAC (1). The whole OOC was separated by screening into pulp and seed. Each fraction was analysed for proximate components.

RESULTS AND DISCUSSION

Proximate composition of OOC

The OOC used in this experiment obtained from expeller processing factories in Tripoli. The results of the proximate composition (Table 1) showed that whole OOC contains very high quantity of ether extract (14.3% on DM). Previous studies indicated that 65–85% of the total fatty acid was composed of oleic acid in olive fat (4). The crude protein content is fairly low in OOC as compared to other animal feeds. It contains a high amount of crude fibre and, therefore, can be considered as bulky feed for ruminants.

It is of interest to observe the difference in the proximate composition between pulp and seed. The ratio of the pulp to seed is approximately 1:1 in the tested whole OOC. It appears from the analytical results (Table 1) that most nutrients, except crude fibre and NFE, are higher in pulp than in seed. The pulp contains most of the protein, fat and ash, whereas, the seed is high in carbohydrates (crude fibre and nitrogen-free extract). The physical nature of the OOC may give the appearance of a concentrate feed, the chemical composition, especially crude fibre, protein and fat, reveals that it should be considered as bulky, roughage type feed.

Due to its physical nature OOC was mixed with commercial concentrate. OOC incorporation in the commercial mesh has greatly affected the concentration of CF, EE and NFE (Table 2).

Palatability of OOC-containing rations

From a short preliminary adjustment period it appeared that dairy heifers had to be starved for 24–48 hours to force them to consume complete OOC rations. However, when OOC was included in commercial concentrate at the level of 70%, animals consumed 4–5 kg OOC-containing ration. The heifers suffered from diarrhoea when they consumed either complete OOC rations or when 70% of the DM in mixture was replaced by OOC. High levels of OOC in the ration resulted in gastro-intestinal disorders in heifers, presumably due to high levels of fat in the diet. Recently it was observed (5,6) that a high level of dietary fat caused abnormal fermentation in the reticulorumen. In the present experiment, at a level of 50% OOC in the mixture, there

Table 4 Mean total bodyweight gain (kgs), daily gain (kgs) and feed efficiency of heifers during the first and second trials.

Group	Total gain	Daily gain (mean + SD)	Feed efficiency[a]
First trial			
1	33.3	0.98 ± 0.20	6.12
2	24.0	0.73 ± 0.31	9.62
3	24.30	0.74 ± 0.35	9.49
Second trial			
1	36.7	1.02 ± 0.07	7.36
2	26.0	0.72 ± 0.07	10.38
3	37.0	0.97 ± 0.36	7.3

[a]Kg feed required per kg liveweight gain

was no feed refusal or gastro-intestinal troubles in the animals. The rations with either 25 or 50% OOC were palatable to the heifers during total feeding periods.

Growth performances

Only 3 animals were involved in each treatment, therefore, the interpretation of the results should be treated with caution. The individual animal variations on weight gain were quite large in both first and second feeding trials (Table 4). It appears from the results that animals on control rations (phase 1 and 2) performed better in respect of weight gain (0.98 and 1.02 kgs/day for first and second feeding trials, respectively) compared to the gains of animals receiving OOC in their rations (0.73, 0.72 kgs/day for 25% OOC mixtures, and 0.74, 0.97 kgs/day for 50% OOC mixtures for first and second feeding trials, respectively). However, these differences were not statistically significant in both trials. Lower weight gains observed of OOC rations compared to control rations could be attributed to the high levels of fat and fibre content of the diets containing OOC (first and second trials), in addition to lower levels of protein content of OOC mixtures in the first trial (Table 2). Therefore, urea addition (2nd trial) resulted in an apparent improvement of the animal performances (daily weight gain, feed efficiency) especially at the 50% OOC mixtures. The heifers receiving 25% OOC in mixtures (2nd trial) maintained a similar pattern of weight gain as was found in the first trial.

High levels of OOC in the rations elevated the fat and fibre concentration of the diet (Table 2). High levels of fat in the ruminants' diet are reported to have adverse effects on cellulolytic bacteria and rumen ammonia production (6). Also it is likely that the hard seed of the OOC might escape fermentation in the rumen thus affecting the overall utilization of the ration. The findings obtained in this study are in agreement with recent work (9) using Barbari lambs in which it was possible to replace commercial concentrate successfully by OOC, with supplemental urea, at the rate of 15, 25, and 50% OOC.

Feed costs

The cost of mixtures and hay during the second trial was calculated on the basis of present market prices (Table 5). The mixtures containing OOC were considerably cheaper than commercial concentrate. The cost of OOC and urea-containing mixed feed was reduced to about 50% when OOC was added at 50% level. The cost per kg weight gain of heifers receiving 50% OOC rations was reduced by 30% compared to cost of gain made by control ration. The group receiving 25% OOC gained less during the period and, therefore, total feed cost appeared to be close to the control group.

Table 5 The cost[a] of commercial concentrate, OOC, roughage and cost per kg liveweight gain (in Libyan Dinars) during the 2nd trial.

	Feed cost				
Group	Commercial concentrate	OOC	Roughage	Total	Cost/kg gain
1	18.00	—	10.80	28.8	0.78
2	13.50	0.45	10.80	24.75	0.95
3	9.00	0.90	10.80	20.7	0.56

[a]The cost of commercial concentrate is based on government rate in Libya.

It may be concluded that OOC can serve as a bulky or semi-bulky energy source for ruminants and that at least 25% of the dry matter of the total commercial concentrate mixture can be replaced by OOC without any adverse effect on the health of the animal. Although OOC is low in crude protein, its nutritive value can be improved by supplementation with urea. The feed cost under local conditions can be considerably reduced by utilizing OOC in the ration of cattle.

Further investigations are under way on the usefulness of OOC for other livestock.

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كسب بذرة الزيتون كغذاء للعجول النامية

م٠أ ٠ رزاق ف٠ الشيخ عمر

مستخلص

تم فى هذه التجربة احلال كسب بذرة الزيتون بنسبة ٢٥ ، ٥٠/ كجزء من المادة الجافه للعليقة المركزه الخالية من كسب بذرة الزيتون (١٦/ بروتين) والتى تعتبر كعليقة مقارنة ٠ غذيت ٣ مجاميع من عجول الفريزيان النامية لمدة ٣٣ يوما (التجربة الاولى) تم اضيفت اليوريا لمخاليط الاعلاف التى تحتوى كسب بذرة الزيتون وذلك لرفع نسبة البروتين بها الى ١٦/ وغذيت عليها نفس مجاميع العجول الفيريزيان لمدة ٣٦ يوما (التجربة الثانية) وقد تم مقارنة هذه الانواع الثلاثه من العلائق من حيث قابلية الحيوان لاستهلاك العليقة ، معدلات النمو وتكاليف انتاج الكيلو جرام من الوزن الحى ٠

وقد دلت النتائج المتحصل عليها على :

١) استهلاك الاعلاف التى تحتوى على كسب بذرة الزيتون كانت مقبوله كغذاء للحيوان ٠

٢) على الرغم من ان العليقة الخاليه من الكسب قد اعطت معدلات نمو وكفاءة غذائية افضل من تلك التى تحتوى على ٢٥/ او ٥٠/ بذرة زيتون لكن الاختلافات لم تكن معنوية ٠

٣) طرأ تحسن ملحوظ فى معدلات النمو بأضافة اليوريا بالتجربة الثانية ٠

٤) كانت تكاليف الغذاء اللازم لانتاج الكيلو جرام الواحد من الوزن الحى اقلها فى العليقة التى تحتوى ٥٠/ كسب بذرة الزيتون مع اضافة اليوريا ٠

من النتائج المتحصل عليها يمكن التوجيه باستخدام كسب بذرة الزيتون كغذاء خشن او شبه خشن لامداد الحيوان المجتر بالطاقه ويفضل استخدامه بنسبة ٢٥/ مع اضافة اليوريا للعليقة المركزه وذلك فى تغذية العجول النامية دون اى اختلافات معنوية فى معدلات النمو او تأثير على صحة الحيوان حتى تكتمل الدراسة الخاصة باستخدام كسب بذرة الزيتون فى تجارب لاحقه ٠