Egypt. J. Vet. Sci. **Vol. 56,** No. 3, pp. 437-448 (2025)

Egyptian Journal of Veterinary Sciences

https://ejvs.journals.ekb.eg/

Effect of Partial Replacement of TMR by Treated Olive Cake on Sheep Performance

Mohamed A. M. Abdellateef [1*], Mohamed S. Farghaly[2], Mohamed A. Hanafy[3], Mohamed H. Bakr[4] and Hassan A.F Rahmy[5]

Department of Animal Nutrition, Faculty of Agriculture, Cairo University, Cairo, Egypt.

Abstract

THE PURPOSE of this study was to assess the effects of replacing 20% of total mixed ration (TMR) by milled olive cake (MOC), with or without adding polyethylene glycol or fibrolytic enzymes on the productive performance of Barki sheep. The first experiment compared five rations in a digestion trial: theR1 ration was a control group TMR without olive cake (OC), R2 was 20% of raw olive cake (ROC), the third was 20% of ROC with polyethylene glycol, the fourth was 20% of MOC, and the fifth was 20% of MOC with polyethylene glycol. The results showed that the use of polyethylene glycol had no significant effect, so the fourth group was the best. The second experiment was Eighteen Barki lamps aged 6 months and 29.5± 5 kg average body weight were randomly divided into three homogeneous groups (six of each). R1 (control) , R2 were fed TMR containing 20% of MOC and the R3 fed a ration of R2 plus adding fibrolytic enzymes. The results showed that dry matter (DM) and organic matter (OM) digestibility were decreased with ration containing 20% MOC, and significant differences in CP digestibility were observed when compared to experimental groups. The different experimental rations did not affect the rumen pH values. There are no significant differences in NH3 in all groups. On the other hand, there were significant differences in total gain, average daily gain, or feed efficiency between the experimental rations and Dry matter intake increased slightly when growing lambs were fed rations R3.

Keywords: lambs, Polyethylene glycol, fibrolytic enzymes, digestibility, growth performance.

Introduction

The dramatic increase in animal feed prices encouraged nutritionists to search for cheaper alternatives to traditional feedstuffs. Feed ingredients like corn or barley grain, soybean meal, and wheat bran are considered the major sources of nutrients for ruminants in our country. Barki sheep has an important economic value in terms of minimizing the shortage of mutton meat in Egypt [1].

Locally available byproducts such as Agro-industrial byproducts could be a suitable solution to reduce the cost of animal feeding [2]. Some byproducts are highly environmentally contaminant, and their use in animal feeding can help to reduce the environmental problems caused by their accumulation and to lower the carbon footprint of animal products when locally produced by products are used [3]. Most byproducts are not potentially edible by humans, additionally, some byproducts contain bioactive compounds that can improve animal health and productive performance [3].

Olive crops and derived industries are economically and socially very important in Mediterranean countries [4]. Egypt is considered one of the major producers, of olive worldwide. Moreover, Egypt is the leader in growing olive

*Corresponding author: Mohamed A.M. Abdellateef, E-mail: mohamed.ae.mahmoud@agr.cu.edu.eg, Tel.: 01276437768
(Received 06/02/2024, accepted 17/04/2024)
DOI: 10.21608/EJVS.2024.260229.1833

in arid and semi-arid conditions on desert lands [5]. Olive cake's chemical composition varies substantially based on several variables, including the olives' qualities, the environment, and the production methods used [6].-

Egypt produces olive cake (olive by-product) almost 60 to 80 thousand tons in the year [7]. On the other hand, Gad et al. [9], found that the average body weight was higher significantly in the Friesian calves receiving 30% of the olive pulp with 20% yellow maize than those fed the control rations.

Mioc et al. [8] investigated the effect of replacing olive cake with part of CFM in the rations of weaned Pramenka lambs, the results showed that the high level of olive cake (30%) decreased the daily body gain, final body weight, empty carcass weight and dressing percentage of the lambs On the other hand, Gad et al. [9], found that the average body weight was higher significantly in the Friesian calves received 30% olive pulp with 20% yellow maize than those fed the control rations. Mostafa et al. [10], and Gad et al. [9] found that no significant changes were detected in transaminase liver enzymes except in the case of ALT where it was slightly elevated. On the other hand, when olive cake was added to rabbit feed, there didn't seem to be any detrimental impacts on blood tests or growth [11].

According to many researchers who made many studies in recent years, replacing different levels of olive cake with grains such as corn or barley in animal rations [12,13].

According to many researchers who made many studies in recent years, replacing different levels of olive cake with grains such as corn or barley in animal rations [12,13].

This study aims to use olive cake in the Barki sheep nutrition:1. Effect of using two forms of olive cake, crude olive cake (COC) or milled olive cake (MOC) on the digestion and nutritive values of the Barki sheep fed the experimental rations. 2. The effects of incorporating milled olive cake (MOC) with or without fibrolytic enzymes (FE) or polyethylene glycol(PEG) in Barki sheep rations on rumen parameters, growth performance, digestibility, some blood parameters, and economic efficiency.

Materials and Methods

The present study was carried out at El-Mokhtar Farm, Kafr Hakim, Kerdasa City, Giza, Egypt and all chemical analyses and digestion trials were conducted at laboratories and research stations of the Faculty of Agriculture Cairo University (Egypt).

The experimental animal endures complied with the institutional guidelines of IACUC (the Institutional Animal Care and Use Committee (IACUC) no. CUIIF1722/ SEPT2022 Cairo University Egypt and were conducted by trained specialized personnel in strict accordance with good animals.

Preparation and chemical analysis of feedstuffs

The crude olive cake was obtained from one of the olive factories located in Badr City (Northeast of Egypt), and then transported to the Faculty of Agriculture Cairo University to be prepared for use in the experimental rations. The collected olive cake was spread on a plastic sheet, sun dried with manual turning and tedding (3–4 times daily), then taken to be milling (MOC) and finally stored in plastic bags until use, in the table (1), show the chemical composition of feedstuff used in the experiment.

Metabolic cages were used to determine the amount of daily feces and feed consumed. This period is divided into 14 days primary stage to adapt animals to the digestion box, where they fed the experimental rations. Another 7 days were used as collection period for the feces samples (10% fresh feces). Samples were dried at 70 °C for 24 hours and kept in polyethylene bags until chemical analysis. Samples of feed ingredients, rations, and feces were chemically analyzed according to AOAC [14], while fiber fractions; neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) were determined Using the ANKOM 200 according to Van Soest et al. [15]. The organic matter (OM) was calculated as the difference between dry matter and ash while nitrogen free extract (NFE) was calculated by the following equation: %NFE= 100 – (CP% + EE%+CF%+ASH%).

Experiment 1

The first experiment aimed to evaluate the effect of two forms of olive cake, to replace part of the mixture TMR, either as a milled olive cake with or without polyethylene glycol (PEG), on the digestion and nutritive values of the experimental rations.

Experimental rations

Five experimental rations were conducted to evaluate crude olive cake (R2 and R3) and milled olive cake (R4 and R5) incorporation in Barki sheep rations with or without PEG supplementations and compared to the control group (R1). Polyethylene glycol (PEG), purchased from El-Gomhouria Company, Cairo, Egypt and added at a rate 2.0 kg / 1000 kg olive cake and mixed according to the recommendation of Ignacio et al,[4]; Ben Salem et al., [16] and Silanikove et al., [17,18]. The formulation of the experimental rations is shown in Table (2).

Experimental animals

Five Barki sheep (45±5 Kg average body weight) under the method of laten square were used for 5 rations (digestion trail). The animals were housed in metabolic cages during the experimental period to determine the digestion coefficients of nutrients and the feeding value of the experimental rations used in the experiment.

Experiment 2

The Second experiment was aimed at evaluating the effect of milled olive cake (MOC), to replace 20% of the total mixture rations (TMR) with or without fibrolytic enzymes on growth performance, rumen parameters, and some blood parameters. In experimental diets R2 and R3, 20% of TMR was replaced by MOC without or with FE, respectively, to study the positive effect of mechanical milling technique.

Hamecozyme is a commercial product manufactured by private company (KEMET) in Egypt. The product is a concentrated powder composed mainly of acid-neutral endo-1,4-β-D-xylanase (Xylanase Plus), protease, cellulase, amylase and beta-glucanase, both multi–enzyme complexes are harmless for people and animals produced by fermentation of non-recombinant *Trichoderma longibrachiatum* (formerly *Trichoderma reesei*). The substrates used for the determination of enzymatic activities were oatspeltxylan (xylanase), carboxymethylcellulose sodium salt (endoglucanase) and cellulose (exoglucanase). The enzyme was added to 0.25% of olive cake [19], then mixed-treated olive cake with other ingredients to make TMR.

Experimental rations

Three experiments were conducted to evaluate milled olive cake (MOC) in Barki sheep rations compared to control, as a non-conventional ingredient. The experimental rations (Exp.2) are shown in Table (3).

Experimental animals and growth trials

Eighteen Barki lambs (6 months old and 29±5 Kg average body weight) were divided randomly into 3 groups (6 of each). The animals were housed during the experimental period (90 days growth period) in a semi-closed house which was divided into three separate places and fed two times per day at 6 am and 4 pm.

TABLE 1. Chemical composition (% DM) of feedstuffs used in the experiment.

Items	Feedstuffs						
	Yellow corn	Wheat bran	Soyabean meal 44%	Undecoraticted cottonseed meal	Olive cake	Egyptian clover hay	Rice straw
				Chemical composition (%):			
DM	88.0	89.5	87.0	92.0	88.0	90.0	90.0
CP	07.7	15.2	44.0	24.0	09.5	12.5	04.0
EE	03.8	03.9	01.5	06.0	05.7	02.3	01.0
CF	02.3	12.0	07.3	23.0	33.0	30.0	40.0
Ash	01.4	06.2	06.5	05.0	07.0	08.0	16.0
				Fiber fraction (%):			
NDF	09.0	46.0	15.0	50.6	62.0	56.0	71.0
ADF	02.2	14.0	10.0	38.6	48.0	41.0	55.0
ADL	01.0	03.0	01.5	11.2	21.0	13.0	05.0
Hemicellulose	06.8	32.0	05.0	12.0	14.0	15.0	16.0
cellulose	12.0	11.0	08.5	27.4	27.0	28.0	50.0

TABLE 2. Formulation of the experimental rations (Exp.1)

Ingredients, %	Experimental Rations[1]				
	R_1 Control	R_2 COC	R_3 COC+PEG	R_4 MOC	R_5 MOC+PEG
Yellow corn grains	26	26	26	26	26
Wheat bran	20	15	15	15	15
Soyabean meal 44%	-	02	02	02	02
Cottonseed meal[2]	20	15	15	15	15
Crude olive cake	-	20	20	-	-
Milled olive cake	-	-	-	20	20
Egyptian clover hay	20	15	15	15	15
Rice straw	10	03	03	03	03
Feed additives[3]	04	04	04	04	04
Polyethylene glycol[4]	-	-	+	-	+

[1] R_1: Control ration without olive cake; R_2: Ration containing 20% COC – PEG; R_3: Ration containing 20% COC + PEG; R_4: Ration containing 20% MOC – PEG; R_5: Ration containing 20% MOC + PEG.

[2] Undecoraticted

[3] Feed additives: NaCl (1%), calcium carbonate(limestone) (2%), vitamins mixture (0.1%), minerals mixture (0.3 %), yeast (0.1%), ammonium chloride (0.2%), disodium phosphate (0.2%) and anti-mycotoxins (0.1%).

[4] Polyethylene glycol (PEG4000) addition level was 0.2 g /100 g olive cake.

TABLE 3. Formulation of the experimental rations (Exp.2)

Ingredients, %	Experimental Rations[1]		
	R_1 Control	R_2 MOC	R_3 MOC+FE
Yellow corn grains	26	26	26
Wheat bran	20	15	15
Soyabean meal 44%	-	02	0 2
Cottonseed meal[2]	20	15	15
Milled olive cake	-	20	20
Egyptian clover hay	20	15	15
Rice straw	10	03	03
Feed additives[3]	04	04	04
Fibrolytic enzymes[4]	-	-	+

[1] R1: Control ration without OC; R2: ration containing 20% MOC - FE; R3: ration containing 20 % MOC + FE.

[2] Undecoraticted

[3] Feed additives: NaCl (1%), calcium carbonate(limestone) (2%), vitamins mixture (0.1%), minerals mixture (0.3 %), yeast (0.1%), ammonium chloride (0.2%), disodium phosphate (0.2%) and anti-mycotoxins (0.1%).

[4] Fibrolytic enzyme was added at 0.25% of olive cake.

During the growth period, lambs were weighed every 14 days before morning feeding after 14 hours of fasting. Both feed and water were provided in sufficient amounts. During the growth experiment three adult rams (45±5 Kg average body weight) under the method of laten square was used for 3 rations. The animals were housed in metabolic cages during the experimental period to determine the digestion coefficients of nutrients and the feeding value of the experimental rations used in the experiment.

Rumen parameters

At the end of the digestion trails, ruminal fluid samples (5 ml) were collected from each sheep before the morning feeding at (0 h) then at 4 h after the morning feeding. Ruminal fluid samples were strained in four layers of cheese cloth, then their pH values were measured immediately after sampling using a pH meter (Fisher Accument, Pittsburgh, PA, USA). The other part of samples was acidified with 3 mol metaphosphoric acid (1:10 dilution), then cooled (4 °C) for 30 min and centrifuged (25,000 ×g; 4 °C; 20 min). Supernatant fluids were removed, and samples were frozen. Volatile fatty acid (VFA) and ammonia N concentrations were determined in these samples according to [20,21] repeatedly.

Blood parameters

At the end of the digestion trails, blood samples were taken from jugular vein in EDTA test tube of animals before morning feeding blood plasma was taken after centrifuging blood samples at 4000 rpm for 20 min and stored in ice at -20°C to determine all other blood parameters. Red blood cells and white blood cells and other parameters were measured using the biuret method as described by Gornall *et al*. [22]. Hemoglobin was measured according to Drabkin *et al*. [23].

Economic efficiency

Economic efficiency of the experimental rations was expressed as the cost of fed consumption for producing one kg body weight gain.

Statistical analysis

The experimental data were statistically analyzed using one-way analysis of variance according to SPSS [24]. By the following model:

$$Y_{ij} = \mu + R_i + E_{ij},$$

where: Yij, is the dependent variable; μ, the overall mean; Ri, the treatment effect; Eij, the experiment error. The significant differences among means were separated according to Duncan's test [25], which considered significant at $p < 0.05$.

Results and Discussions

Experiment 1

Proximate analysis and fiber fractions of the experimental rations containing crude olive cake (COC) or milled olive cake (MOC) with or without polyethylene glycol is shown in Table (4). The results showed that the differences were not significant in the control rations (R1) and other experimental rations on the value of the DM, OM, CP, EE, CF, ASH, Silica, and NFE, however, the percentages of CF and fiber fractions tended to increase with the replacement level (20%) of COC or MOC in the experimental rations compared to the control group. It is worth noting that the percentages of NDF, ADF, ADL, cellulose, and hemicellulose were decreased in the R_1 .control shares compared to the other treatments.

This might be due to the increase of the CF% and fiber fractions because the CF and its fractions content in COC and MOC are higher than its contents in replacement feed ingredients. These results are agreement with Sansoucy *et al*. [26] and Kotsampasi *et al*. [13].

Digestion coefficients and nutritive values

The results of digestion coefficients and nutritive values of the experimental rations are shown in Table (5).

Results of digestion coefficients and nutritive values showed that experimental rations containing COC or MOC with or without PEG had low values compared with the control group and the MOC groups with (R5) or without (R4) PEG had higher values than those the COC group with (R3) or without (R2) PEG. The digestion coefficients and nutritive values of PEG (R5 and R3) groups showed higher values compared with the (R_4 or R_2) rations. These results may be explained by PEG supplementation may improve the digestion coefficients and nutritive values of rations containing COC or MOC and the results of PEG with MOC is better than its effect with group COC. Similar results were obtained by [27,28].

In the case of nutritive value there are significant differences between rations 4 and 5 which have MOC compared with rations 2 and 3 in TDN and DCP and in the same way there are no significant differences between rations without polyethylene glycol and rations with polyethylene glycol.

TABLE 4. Proximate analysis and fiber fractions of the experimental rations (Exp.1)

Items	Experimental Rations				
	R_1 Control	R_2 COC	R_3 COC+PEG	R_4 MOC	R_5 MOC+PEG
Chemical composition (%)					
DM	94.00	94.07	93.95	93.86	94.12
OM	87.80	87.30	86.80	87.40	87.15
CP	12.78	12.38	12.40	12.43	12.45
EE	03.30	03.80	03.70	03.75	03.60
CF	16.80	17.40	17.30	17.55	17.60
Ash	06.20	07.40	07.15	06.46	06.97
Silica	04.40	04.80	04.37	04.90	04.85
NFE	54.92	53.09	53.40	53.67	53.40
Fiber Fraction (%)					
NDF	38.54	48.89	48.69	49.09	48.99
ADF	27.77	34.77	34.55	34.83	34.85
ADL	08.34	10.25	10.05	10.38	10.28
Cellulose	19.43	20.65	24.50	24.45	24.57
Hemicelluloses	10.77	14.12	14.14	14.26	14.14

R1: Control ration without olive cake; R2: Ration containing 20% crude olive cake (COC) – PEG; R3: Ration containing 20% COC + PEG; R4: Ration containing 20% milled olive cake (MOC) – PEG; R5: Ration containing 20% MOC + PEG.

TABLE 5. Digestion coefficients and nutritional values of the experimental rations (Exp.1)

Items	Experimental Rations					SE	P value
	R_1 Control	R_2 COC	R_3 COC+PEG	R_4 MOC	R_5 MOC+PEG		
Nutrient digestibility (%)							
DM	70.45^a	50.10^d	50.18^d	60.22^c	63.43^b	2.1026	<.001
OM	70.64^a	50.20^e	52.69^d	60.30^c	64.80^b	2.0232	<.001
CP	70.55^a	50.42^e	51.76^d	60.52^c	62.33^b	1.9775	<.001
EE	70.31^a	51.20^e	54.47^d	60.85^c	64.65^b	1.8409	<.001
CF	60.56^a	50.12^d	51.71^c	59.33^b	61.18^a	1.2573	<.001
NFE	78.37^a	63.22^d	62.80^d	70.18^c	75.68^b	1.6947	<.001
NDF	50.62^a	40.72^d	40.01^d	42.07^c	43.74^b	1.0222	<.001
ADF	45.09^a	34.44^c	34.72^c	38.01^b	38.30^b	1.0300	<.001
Cellulose	64.95^a	40.12^c	40.21^c	41.09^b	41.13^b	2.6034	<.001
Hemicelluloses	67.23^a	48.78^b	48.93^b	49.15^b	49.33^b	1.9484	<.001
Nutritive value (%)							
TDN	67.45^a	53.31^e	54.83^d	62.13^c	63.82^b	1.4476	<.001
DCP	09.02^a	06.24^c	06.42^c	07.52^b	07.76^b	0.2868	<.001

R1: Control ration without olive cake; R2: Ration containing 20% COC – PEG; R3: Ration containing 20% COC + PEG; R4: Ration containing 20% MOC – PEG; R5: Ration containing 20% MOC + PEG; TDN: total digestible nutrients; DCP: digestible crude protein.

Many researchers discovered that NDF, ADF, and CP digestibility were reduced, possibly because of heat during the oil extraction process, heating reduces the availability of CP (i.e., Maillard's reaction) [29] because most of the N is attached to carbohydrates and thus unavailable to rumen microbes [30].

According to the results at the end of experiment 1, the PEG did not have a significant effect on nutrient digestibility and nutritive value of experimental rations compared to the control group. The milling treatment had a significant effect on nutrient digestibility and nutritive value of experimental rations compared to the control group. So, the conclusion is study of the effect of MOC in experiment 2, and without PEG, and study the effect of fibrolytic enzymes on sheep performance.

Experiment 2

Nutrient digestibility, nutritive values, and fiber fraction

Results obtained in Table (6) cleared that the digestion coefficient of all feed nutrients in R_1 was significantly (P>0.05) higher compared with other treatments, except for DM or CF differences were not significant (P>0.05) for the rations (R3). It reflects on the values of DCP and TDN of the rations (R3) which were higher than that of the rations (R2) and lower compared with the control rations (R1). So, the effect of fibrolytic enzyme supplementation may increase the digestion coefficient and nutritive values [31].

Rumen parameters

As shown in Table (7), there is no significant difference between experimental groups and control in rumen parameters. This finding could imply that condensed tannins inhibit carbohydrate fermentation in the rumen. as observed the decrease in all rations pH, ammonia, and total volatile fatty acids after 4 hours of feeding may result because of high concentrates in all rations that ranged 70 -82 % that causing pH meter to decrease and acidity increasing which effect on microorganisms in animal's rumen, so it decreases the production of both ammonia and volatile fatty acids.

May can see that When sheep and goats were fed tannin-containing shrubs like olive cake, and these results agreed with [18,32,33].

Growth performance and economic efficiency

Growth performance results are shown in Table (8) the lambs fed R_2 recorded lower values of total gain and ADG compared with R3 and control rations. However, differences were not significant (p<0.05). This might be due to the feeding growing lambs on MOC containing fibrolytic enzymes increased dry matter intake slightly more than that the R_2 rations, which also, could be attributed to the effect of tannin content in olive cake on nutrient digestibility, particularly the CF. Furthermore, all results were comparable in terms of the nutritional values of the experimental rations.

When growing lambs were fed rations containing 15% DM olive cake with or without yeast, these results agreed with Obeidat et al. [28]. Vargas-Bello-Pérez et al. [34] investigated DM intake in ewes fed rations containing olive cake at 9.8% or 24.4% of dietary DM or in growing lambs fed rations containing 10% or 20% olive cake [35]. The same results were obtained when male lambs were fed a concentrate mixture that included 20% de-stoned olive cake [36,37]. On the other hand, feed conversion (DMI kg/kg gain) was significantly improved in lambs fed R1 or R3 rations compared with the lambs fed ration R2.

The daily cost of TMR (LE/Kg) was decreased by using MOC (R2) and MOC+FE(R3) compared to the control group (R1) (7.3% and 6.83% respectively). Economic efficiency (cost of feed for producing one Kg of body weight gain (Kg) was 26.21, 31.26 and 25.88 in R1, R2 and R3 respectively; the rations R3 achieved the best result. So, it's recommended to use the rations containing MOC+FE, which decreases the feed cost and improves the production performance of lambs and increases the profitability of sheep farms. These results agreed with Farghaly M.S., [38].

Blood parameters.

Results obtained in Table 9, cleared that there were no significant differences between rations in all blood parameters, as red and White blood cells, Hemoglobin, anemia, Platelet and procalcitonin between lambs fed rations R_2 or R_3 compared with the lambs fed the control rations R_1,which means that there is no effect by using MOC with fibrolytic enzymes on all blood parameters and these results agree with that observed by Fourie [39] Duncan *et al*. [40]. Peter *et al*. [41], Naseir [42].

TABLE 6. Digestion coefficient and nutritional values of the experimental rations with or without fibrolytic enzymes (Exp. 2).

Items	Experimental Rations				
	R_1 Control	R_2 MOC	R_3 MOC+FE	SE	P value
Nutrient digestibility (%)					
DM	70.45[a]	60.22[b]	67.60[a]	2.1026	<.001
OM	70.64[a]	60.30[c]	68.99[b]	2.0232	<.001
CP	70.55[a]	60.52[c]	65.16[b]	1.9775	<.001
EE	70.31[a]	60.85[c]	62.58[b]	1.8409	<.001
CF	60.56[a]	51.33[b]	59.73[a]	1.2573	<.001
NFE	78.37[a]	70.18[c]	73.26[b]	1.6947	<.001
NDF	50.62[a]	42.07[c]	45.99[b]	1.0222	<.001
ADF	45.09[a]	38.01[c]	40.98[b]	1.0300	<.001
Cellulose	64.95[a]	41.09[c]	50.07[b]	2.6034	<.001
Hemicelluloses	67.23[a]	49.15[c]	59.25[b]	1.9484	<.001
Nutritive value (%)					
TDN	67.45[a]	62.13[c]	63.08[b]	1.4476	<.001
DCP	09.02[a]	07.52[c]	08.13[b]	0.2868	<.001

R1: Control ration without OC; R2: ration containing 20% MOC - FE; R3: ration containing 20 % MOC + FE. TDN: total digestible nutrients; DCP: digestible crud protein

TABLE 7. Effect of fibrolytic enzymes of the experimental rations on rumen parameters (Exp.2).

Items	Experimental Rations				
	Sample time	R_1 Control	R_2 MOC	R_3 MOC+FE	P value
PH	zero	07.55	07.46	07.80	0.626
	4 hours	06.61	06.55	06.79	
Ammonia N, mg/l	zero	32.00	32.46	32.80	0.391
	4 hours	30.57	30.35	30.67	
Total volatile fatty acid, mmol/l	zero	10.98	10.34	10.32	0.997
	4 hours	09.21	09.87	09.92	

R1: Control ration without OC; R2: ration containing 20% MOC - FE; R3: ration containing 20 % MOC + FE.

TABLE 8. Effect of fibrolytic enzymes of the experimental rations on growth performance of lambs (Exp.2)

Items	Experimental Rations			
	R_1 Control	R_2 MOC	R_3 MOC+FE	P value
Initial body weight, kg	30.75±3.50	30.83±3.50	32.43±3.00	0.913
Final body weight, kg	44.83±3.00 [a]	41.78±3.20[c]	45.71±4.00 [b]	0.385
Total body weight gain, kg	14.08±1.90[a]	10.94±3.00[c]	13.28±2.99[b]	<.001
Total body weight gain, g/90-day	156.44±0.1[a]	121.43±0.02[c]	147.56±0.011[b]	<.001
Dry matter intake, g / head / day	1134[a]	1089[b]	1172[a]	<.001
Feed conversion ratio DMI g/ gain, g	07.25[b]	08.95[a]	07.94[b]	<.001
Daily cost for TMR, LE/kg	04.10	03.80	03.82	0.216
Economic efficiency	26.21[b]	31.26[c]	25.88[a]	<.001

R1: Control ration without OC; R2: ration containing 20% MOC - FE; R3: ration containing 20 % MOC + FE. Ingredient price: Yellow corn 4200 LE /ton, wheat bran 4000 LE /ton, Soyabean meal 7800 LE / ton, Undecoraticted cotton seed meal 6400 LE / ton, olive cake (after preparation) 1000 LE / ton, Egyptian clover hay 2500 LE / ton, Rice straw 400 LE / ton. Economic efficiency= cost of kg TMR, LE / average body weight gain, kg; LE: Egyptian pound.

TABLE 9. The effect of fibrolytic enzymes of the experimental rations on blood parameters.

Items	Experimental Rations				
	R_1 Control	R_2 MOC	R_3 MOC+FE	Range (References)	P value
WBC *10/L	11.60	12.00	11.40	4.0–12.0 [38]	00.765
RBC *10/L	15.36	15.11	15.44	8.0–18.0 [38]	0.916
HGB g/dl	11.60	12.96	11.13	9·5–13·5 g. per 100 ml [36]	0.145
HCT %	28.40	30.83	31.83	27.0–45.0 [38]	0.014
MCV FL	32.50	31.30	30.20	28–40 [38]	0.141
MCH pg.	09.80	09.50	09.40	8.0–12.0 [38]	0. 881
MCHC g/dL	33.65	34.13	34.85	31–34 [38]	0.393
RDW %	18.40	18.76	18.76	14.6-25.5.[39]	0. 881
PLT *10/L	454.50	434.33	464.00	240 – 700 [37]	0.950
MPV FL	05.90	05.10	05.40	4.7-7.4.[39]	0.635
PDW%	25.45	25.60	25.23	23.5-36.6.[39]	0.903
PCT %	00.17	00.23	00.16	0.02-0.35.[39]	00.933

R1: Control ration without OC; R2: ration containing 20% MOC - FE; R3: ration containing 20 % MOC + FE. WBC :White blood cells , RBC : red blood cells , HGB : Hemoglobin Test , HCT : Hematocrit test , MCV : the average size of red blood cells, MCH : mean corpuscular hemoglobin, MCHC : amount of hemoglobin in a single red blood cell (RBC) , RDW: complete blood count (CBC) anemia test , PLT: the number of platelets in , MPV: the size of platelets, , PDW: Platelet Distribution Width , PCT: the level of procalcitonin.

Conclusion

The milled olive cake (MOC) can be used by 20% in growing sheep total mixed ration (TMR) and with fibrolytic enzymes supplementation without any negative effect on digestibility, blood parameters or sheep performance especially under arid and semiarid conditions. These feed strategies can improve the profitability of sheep forms and decrease environmental pollution and increase the sustainability of animal production projects in Egypt.

Acknowledgment

The authors wish to thank El-Mokhtar Farm for supporting and providing the experimental animals as well as the facilities for this work and Faculty of Agriculture, Cairo University for supporting and providing the Chemical analyses were done at laboratories and the experimental animals as well as the facilities for this work.

Conflicts of interest

Authors do not have any conflicts of interest to declare**.**

References

1. AOAC, (2019) Official methods of analysis, 21st ed., AOAC International, Gaithersburg, MD, USA.
2. Ibrahim A., Henry R., Michael O., Eduard M., Mosaad M., Mohamed A. R., Ismail M. and Klaus W. Analysis of Candidate Genes for Growth and Milk Performance Traits in the Egyptian Barki Sheep; *Animals* (basal) , **10**(2), 197(2020).
3. Estaún J., Dosil, J., Al Alami, A., Gimeno, A. and De Vega, A. Effects of including olive cake in the diet on performance and rumen function of beef cattle. *Animal Production Science*, **54**, 1817-1821(2014).
4. Trinidad de Evan; Almudena Cabezas; Jesús de la Fuente and María Dolores Carro. Feeding Agro-industrial Byproducts to Light Lambs: Influence on Growth Performance, Diet Digestibility, Nitrogen Balance, Ruminal Fermentation, and Plasma Metabolites; *Animals*; **10**,600(2020).
5. Ignacio Martín-García; David Yáñez-Ruiz; Abdelmajid Moumen and Eduarda Molina-Alcaide. Effect of polyethylene glycol; urea and sunflower meal supply on two-stage olive cake fermentation. *Anim. Res*., (**53**), 245–257(2004).
6. Noha, M. W., Shimaa A. S., Ahmed, I. A., Zeinab, S., Asmaa, S. and Samer, S. I. Economic, Productive, and Behavioral Evaluation of Using Dried Olive Cake and Ground Date Palm in Growing Rabbit's Diet: Histological and Gene Expression Impact; *Egyptian Journal of Veterinary Sciences*, **55** (5), 1447-1471(2024).
7. Grattan, S. R., Berenguer, M. J., Connell, J. H., Polito, V. S. and Vossen, P. M. Olive oil production as influenced by different quantities of applied water; *Agricultural Water Management*, **85**, 133-140(2006).
8. International olive oil council ;(2022); https://www.internationaloliveoil.org/the-world-of-olive-oil .
9. Mioc, B., Pavic, V., Vnucec, I., Prpic, Z., Kostelic, A. and Susic, V. Effect of olive cake on daily gain, carcass characteristics and chemical composition of lamb meat.*Czech J. Anim. Sci*., **52**,31-36(2007).
10. Gad, A.E., Fatma, E.I., Team, F. E.I. and Mostafa, M.M. Effect of different concentrations of olive pulp on body weight and some biochemical parameters in Friesian calves; *Isotope & Radiation Res*., **40** ,1195-1204(2008).
11. Dildar, S. Ahmad, and Alaa, H. A. A. Impact of Untreated Olive Pulp on Haematological and Growth Performance in Broiler Treated with ND vaccine; *Egyptian Journal of Veterinary Sciences*, **54** (4), 579-588(2023).
12. Mostafa, M.R.M., Salama, R., Lashin, M.E. and Abodo, A.A. Utilization of olive cake in fattening rations of Rahmani lambs. *J. Nutr. Feeds*, **6**,811-820(2003).
13. Obeidat, B.S., Shdaifat, M.M., Al-Barakah, F.S. and Kanan, A.Q. The effect of feeding agricultural by-products on performance of lactating Awassi ewes. *Small Rumin. Res*., **113**, 11–14(2013).
14. Kotsampasi, B., Bampidis, V.A., Tsiaousi, A., Christodoulou, C. and Christodoulou, V. Effects of dietary partly de- stoned exhausted olive cake supplementation on performance, carcass characteristics and meat quality of growing lambs. *Small Rumin. Res*., **156**,33-41(2017).
15. AOAC, (2019). Official methods of analysis, 21st edn. AOAC International, Gaithersburg, MD, USA

16. Van Soest, P. J., Robertson, J. B. and Lewis, B. A. Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition; *Dairy Sci.*, **74**, 3583-3597(1991).

17. Ben Salem, H., Nefzaoui, A., Ben Salem, L. and Tisserand, J.L. Deactivation of condensed tannins in Acacia cyanofillaLindl foliage by polyethylene glycol in feed blocks. Effect on feed intake, ration digestibility, nitrogen balance, microbial synthesis, and growth by sheep*; Livest. Prod. Sci*., **64**, 51–60(2000).

18. Silanikove, N., Nitsan, Z. and Perevolotsky, A. Effect of a daily supplementation of polyethylene glycol on intake and digestion of tannin-containing leaves (Ceratoniasiliqua) by sheep; *J. Agric. Food Chem*., **42**,2844–2847(1994).

19. Silanikove, N., Gilboa, N. and Nitsan, Z. Interactions among tannins, supplementation, and polyethylene glycol in goats fed oak leaves; *Anim. Sci*., **64,** 479–483(1997).

20. Shaaban, M. M., Hanafy, M. A., Abdul-Aziz, G.M., Mostafa,M.M.M. and Habeeb, A. A. M. Performance of barki sheep fed on rations containing dried or ensiled olive cake with or without fibrolytic enzymes addition; *J. of Appl. Sci*., **31**(2), 9-24 (2016).

21. Erwin, E.S., Marco, G.J. and Emery, E.M. Volatile Fatty Acid Analyses of Blood and Rumen Fluid by Gas Chromatography. *Journal of Dairy Science*, **44**, 1768-1771(1961).

22. McCullough, H. The determination of ammonia in whole blood by a direct colorimetric method*; Clinica Chimica Acta*, **17**, 297-304(1967).

23. Gornall, A.G., Bardawill, C.J. and David, M.N. Determination of serum proteins by means of the Biüret reaction. *The Journal of Biological Chemistry*, **177**, 751-766(1949).

24. Drabkin, D.L. and Austin, J.H. Spectrophotometric Studies:I. Spectrophotometric Constants for Common Hemoglobin Derivatives in Human, Dog, and Rabbit Blood. *Journal of Biological Chemistry*, **98**, 719-733(1932).

25. SPSS, 2019. Statistical Package for Social Science; program version **19**

26. Duncan D.B. Multiple Range and Multiple F-Tests. *Biometrics, Scientific Research*, **11**, 1-42(1955).

27. Sansoucy, R., Alibes, X., Berge, P.H., Martilotti, F., Nefzaoui, A. and Zoïopoulos, P. Olive By-products for Animal Feed; *FAO Animal Production and Health*, **43**, 43-46(1985).

28. Al-Jassim, R.A.M., Awadeh, F.T. and Abodabos, A. Supplementary feeding value of urea treated olive cake when fed to growing Awassi lambs. *Anim. Feed Sci. Technol*., **64**, 287-292(1997).

29. Obeidat, B. S. The effects of feeding olive cake and Saccharomyces cerevisiae supplementation on performance, nutrient digestibility, and blood metabolites of Awassi lambs; *Anim. Feed Sci. Technol*., **231**, 131-137(2017).

30. Martín García A., Moumen, A., Yáñez Ruiz, D. and Molina Alcaide, E. Chemical composition and nutrients availability for goats and sheep of two-stage olive cake and olive leaves; *Animal Feed Science and Technology*, **107**, 61-74(2003).

31. Molina-Alcaide, E., Yáñez-Ruiz, D., Moumen, A. and Martín García, I. Chemicalcomposition and nitrogen availability of some olive by-products; *Small Rumin. Res*., **49**, 329–336(2003).

32. Khalil A., Jihene J., Hela Y., Atef M., Jamel R. and Mohamed K. In vitro study on the effects of exogenic fibrolytic enzymes produced from Trichoderma longibrachiatum on ruminal degradation of olive mill waste. *Arch. Anim. Breed*., **65**, 79–88(2022).

33. Moujahed, N., Kayouli, C., Thewis, A., Beckers, Y. and Rezgui, S. Effects of multinutrient blocks and polyethylene glycol 4000 supplies on intake and digestion by sheep fed Acacia cyanophylla Lindl. foliage-based diets. *Animal Feed Science and Technology*, **88** (3-4), 219-238(2000).

34. Martín-García, I., Yáñez-Ruiz, D., Moumen, A. and Molina-Alcaide, E. Effect of polyethylene glycol, urea, and sunflower meal supply on two-stage olive cake fermentation. *Animal Research*, **53**, 245-257(2004).

35. Vargas-Bello-Pérez, E., Vera, R.R., Aguilar, C., Lira, R., Pena, I. and Fernandez, J. Feeding olive cake to ewes improves fatty acid profile of milk and cheese. *Anim. Feed Sci. Technol*., **184**, 94-99(2013).

36. Tufarelli, V., Introna, M., Cazzato, E., Mazzei, D. and Laudadio, V. Suitability of partly destoned exhausted olive cake as by-product feed ingredient for lamb production. *Journal of Animal Science*, **91**,872-877(2013).

37. Ragni, M., Melodia, L., Bozzo, F., Colonna, M.A., Megna, V., Toteda, F. and Vicenti, A. Use of a de-stoned olive pomace in feed for heavy lamb production. *J. Anim. Sci*., **2** ,485–487(2003).

38. Abbeddou, S., Riwahi, S., Iñiguez, L., Zaklouta, M., Hess, H.D. and Kreuzer, M. Ruminal degradability, digestibility, energy content, and influence on nitrogen turnover of various Mediterranean by-products in fat-tailed Awassi sheep; *Anim. Feed Sci. Technol*., **163**, 99-110(2011).

39. Farghaly, M.S., Abd Elbaset, E. E. and Eid M. M. Performance of Barki Lambs Fed on Rations Containing Olive Cake with or Without Polyethylene Glycol. *Pak. J. Biol. Sci*.; **21**,307-313(2018).

40. Fourie, P.J.J. The haematology and pathology of haemonchosis in sheep; *Union S. Africa Dep. Agric. Vet. Anim. Ind. Rep*.,72 pages (1931).

41. Duncan, J.R. and Prasse, K.W.(1986). Normal hematology of cattle, sheep, and goats; Veterinary laboratory medicine - Clinical Pathology, 2nd ed., Ames, IA Iowa State University.

42. Peter, G.G. J. and Peter, D. C. Clinical Examination of Farm Animals. Blackwell Science Ltd. *Veterinary Medicine*, **331**, 1819–1822 (2002).

43. Naseir M. B. Evaluation of some hematological values and ferritin concentration in normal and emaciated Iraqi sheep. *Kufa, Journal for Veterinary Medical Science*, **5**, 2(2014).DOI:https://doi.org/10.36326/kjvs/2014/v5i24176

تأثير الاستبدال الجزئي لـ TMR بواسطة كسب الزيتون المعامل على الأداء الإنتاجي للأغنام

محمد حسن بكر، محمد سيد فرغلي، محمد أحمد حنفي، محمد عبد العال محمود عبد اللطيف وحسن عوني فؤاد رحمي

قسم الإنتاج الحيواني - كلية الزراعة - جامعة القاهرة - 12613 الجيزة - مصر.

كان الغرض من هذه الدراسة هو تقييم تأثير استبدال 20% من إجمالي العليقة المختلطة (TMR) بتفل الزيتون المطحون (MOC)، مع أو بدون إضافة البولي إيثيلين جلايكول أو الإنزيمات المحللة للالياف على الأداء الإنتاجي لأغنام البرقي. كانت التجربة الأولى تجربة هضم وقارنت خمس علائق وهي: العليقة الأولى كانت عبارة عن مجموعة كنترول TMR بدون تفل الزيتون، والثانية كانت 20% من تفل الزيتون الخام، والثالثة كانت 20% من تفل الزيتون الخام مع البولي إيثيلين جلايكول، والرابعة كانت 20%. % من تفل الزيتون المطحون، والخامس 20% من تفل الزيتون المطحون مع البولي إيثيلين جلايكول وقد أظهرت النتائج أن استخدام البولي إيثيلين جلايكول ليس له تأثير معنوي، وكانت العليقة الرابعة هي الأفضل. علي الجانب الاخر التجربة الثانية تكونت من ثمانية عشر حولي برقي بعمر 6 أشهر ومتوسط وزن جسم 29.5 ± 5 كجم تم تقسيمها عشوائياً إلى ثلاث مجموعات متجانسة (ستة من كل مجموعة). تم تغذية المجموعة الأولى علي عليقة كنترول TMR بدون تفل زيتون مطحون، وتم تغذية الحملان في المجموعة الثانية بـ TMR يحتوي على 20٪ من تفل الزيتون المطحون بديل جزئي من TMR، وتم تغذية حيوانات المجموعة الثالثة (R3) بعليقة كما المجموعة الثانية R2 بالإضافة إلى إضافة انزيمات محللة للألياف.أظهرت النتائج أن هضم المادة الجافة (DM) والمادة العضوية (OM) انخفض مع العليقة التي تحتوي على 20% تفل زيتون مطحون بينما لوحظ اختلافات كبيرة في هضم CP عند مقارنتها بالمجموعات التجريبية. لم تؤثر العلائق التجريبية المختلفة على قياس حموضة الكرش. وأيضا لا توجد فروق ذات دلالة إحصائية في NH3 في جميع المجموعات. من ناحية أخرى، كانت هناك اختلافات معنوية في معدل النمو الكلي أو معدل الزيادة اليومية أو كفاءة التغذية بين العلائق التجريبية وزاد الماكول من المادة الجافة قليلاً عندما غذيت الحملان النامية على علائق R3.

الكلمات الدالة: الحملان، البولي إيثيلين جلايكول، الإنزيمات المحللة للألياف ، الهضم، أداء النمو.