OLIVE CAKE MEAL AS PARTIAL OR COMPLETE SUBSTITUTE FOR CLOVER HAY IN GROWING RABBIT DIETS.

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SUMMARY

Sixty weaned male New Zealand white rabbits of four weeks age were divided to 5 similar groups of (12) rabbits. Each group was divided to 3 replicates of 4 rabbits each. Rabbits of each replicate were placed in wire single floor cage. In this study Olive cake meal (OKM) was incorporated into the basal diet to replace clover hay (CH) at 0, 25, 50, 75 and 100% of the diet. All the tested diets were iso caloric–iso nitrogenous and in pelleted form. The criteria studied were live weight (LW), weight gain (WG), growth rate (GR), feed consumption (FC), feed efficiency (FE), digestibility coefficients (DC) and the nutritive values of the tested diets. The slaughter test was carried out at the end of the experiment on three representative rabbits from each treatment. The economic efficiency (EE) of the product was also calculated. The blood metabolites (glucose, creatinine, total protein, glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), alkaline phosphatase and blood urea nitrogen) were determined.

The results obtained seemed to justify the following conclusion: Body weight with 75 % (OKM) incorporation recorded 2.14% higher than that of the control group. Average daily weight gain (DWG) during the whole experiment period (5-13 weeks) amounted 25.64, 25.21, 22.08, 26.82 and 24.74g on diet with 0, 25, 50, 75 and 100% (OKM) incorporation, respectively, showing that diet composition had no significant effect on (DWG). Rabbits fed at all levels of CH substitution consumed less feed than those rabbits fed on the basal diet. The feed conversion during the whole experimental period indicated the superiority of 75% replacement of CH by OKM (6.3% more than that of the control group). Dressed weight % was the highest (50.14%) in 75% OKM replacement diet, while that of complete replacement recorded the lowest one (44.71%). The net revenue per rabbit was 12.2, 12.2, 90, 14.0 and 10.6 L.E for treatments 1, 2, 3, 4 and 5 respectively, showing that the net revenue per rabbit was the highest in group 4 in which OKM replaced 75% of CH followed by the control group. The economic efficiency (EE) % was the highest with diet 75% OKM replacement of CH followed by that of control group and group 2 in which only was replaced 25% of CH.

Accordingly OKM, as a cheaper agro-industrial by-product, could be incorporated without any harmful effect on rabbits and economic efficiency. Generally, it appears that the inclusion of OKM to replace 75% OF CH in rabbit diets is practically and economically the most effective. In addition OKM as a cheep by-product could be used without any harmful effect on growth and carcass characteristics of NZW rabbits. Concentration of glucose and values of GOT or GPT in all groups of OKM replacement to CH in rabbit diets were higher than those in rabbit serum of control group and was vice versa with ALP concentration. Significant differences among treatment groups were observed for the digestibility of DM, OM, CF, CP, EE and NFE. The nutritive values of the experimental diets expressed as TDN was 63.4, 66.64, 61.50, 61.34 and 60.42 % for diets 1, 2, 3, 4 and 5, respectively and the corresponding values as DCP were 12.99, 12.43, 12.07, 11.77 and 11.4%, showing that TDN or DCP values significantly ($P< 0.05$) decreased as OKM inclusion rate was more than 75% of CH. The observed decrease in TDN or DCP which followed the increase in OKM inclusion may be attributed to the depression in CP and CF digestibility of OKM. The digestible energy (DE) values of the experimental diets were 2803, 2934, 2714, 2707 and 2664 kcal/kg DM of diets 1, 2, 3, 4 and 5, respectively.

From nutritional point of view clover hay is preferable for ruminants and olive cake meal (as an agro-industrial by-product) is most preferable for rabbits. Therefore, the present results could help the nutritionists for choosing the best feedstuffs for the suitable animals.

Keywords: *olive cake meal, rabbits, performance, digestibility, carcass characteristics, economics evaluation.*

INTRODUCTION

There is a big interest in the increase of rabbit production in many developing countries because the average human consumption of animal protein in those countries is lower than the recommended amount of 21g / person day. Rabbits can be raised without important competition with humans for grains, can be a useful alternative. They can be a very important source of high quality animal protein in developing countries.

Clover hay has a good value when made at the correct age and it must be made before it flowers. Hay of all types is a roughage, and different types are very variable in composition. Good quality hay is an excellent food for rabbits, and most breeders agree that it should be fed when available.

Attia (1994) found that feeding Dutch growing rabbits on concentrate ration or mixtures of fiber source such as hay meal up to the extent of 20% of the feed mixture or graduated levels (20, 40 and 60%) not only gave the best performance but also revealed marked improvement in meat characteristics, while rearing these rabbits on higher levels of hay is not sufficient for meat production. Abou-Ela *et al.* (1976) found that feeding growing rabbits on ration containing 25% starch value (SV) for clover hay and 75% (SV) from concentrates followed by that of 1:1 (SV) from clover hay and concentrate might improve the growth and carcass characteristics but rearing rabbits on clover hay alone or concentrates alone is not sufficient for meat production.

There are several possible explanation for the low growth rate of rabbits fed high energy, low fiber diet. Olive oil by-product may be defined as the residue from the solvent (hexane or trichloroethylene) extraction. The total residue consists approximately of 60% kernel and 40% pulp (including the skin). The former has little or no nutritional value and because of its high gross energy per kilogram, it can be exploited as a source of fuel. It is true to say that very little experimentation has been done to exploit residue for rabbit feeding.

Therefore, the present work aimed to evaluate olive cake meal as a partial or complete substitute for clover hay which is more valuable for ruminants. Results obtained could help rabbit producers in choosing the suitable and cheap ingredients in formulating rabbit diets.

MATERIALS AND METHODS

Sixty weaned male NZW rabbits of four weeks age were divided according to body weight into 5 similar groups of (12) rabbits. Each group was divided into 3 replicated of 4 rabbits. Rabbits of each replicate were placed in wire single floor cage. Rabbits were housed in galvanized wire cages (50 x 40 x 40 cm) provided with stainless steel feeders and automatic watering system.

In the present investigation olive cake meal (OKM) was incorporated into the basal diet (control diet) to replace clover hay (CH) with the percentage of 0, 25, 50, 75 and 100% of the diet as shown in Table (1). All the tested diets were iso caloric – iso nitrogenous and in pelleted form. All the experimental diets have the same level of crude protein (CP), crude fiber (CF) and care was undertaken to cover the nutrient requirements of rabbits according to NRC 1977.Fresh water and diets were offered *ad lib* during the experimental period. All rabbits were kept under same managerial, hygienic environmental conditions during the experimental period.

During the experimental period, rabbits were individually weighed to the nearest gram every week before offering the morning meal at 08.00 a.m. up to 13 weeks of age. The average body weight (ABW), body weight gain (BWG), feed consumption (FC) and feed conversion (FC) were recorded and calculated weekly up to 13 weeks of age. At the age of 13^{th} week, three representative rabbits from each feeding group were taken at random to study the carcass characteristics. The blood metabolites of slaughtered rabbits of glucose (W.H.O, 1978), creatinine (Husdan, 1968), total protein (Peters, 1968), glutamic oxaloacetic & pyruvic transaminase (GOT and GPT) were tested according to Retiman and Frenkle (1957), alkaline phosphatase (Belfield and Godberg, 1971) and blood urea nitrogen (Pattoon and Crauch, 1977). Biochemical parameters were estimated using commercial kits biomerieux, France.

Digestion trials were conducted at the termination of the experiment for evaluation of the experiment diets. Three random rabbits per each treatment were used to determine the digestion coefficients of DM, OM, CP, CF, EE and NFE. Feces were collected daily and dried at 60 C°, finely ground and stored for

chemical analysis. The chemical composition of the experimental diets and feces were analyzed according to A.O.A.C (2000). The digestible energy (DE) values of the experimental diets were calculated using the equation of Schiemann *et al.* (1972): DE (kcal/g) = 5.28 X_1 + 9.51 X_2 + 4.2 (X_3 + X_4).

Where:

X_1 = DCP (digestible crude protein, g/kg).

X_2 = DEE (digestible ether extract, g/kg).

X_3 = DCF (digestible crude fiber, g/kg).

X_4 = DNFE (digestible nitrogen-free extract, g/kg).

Economical efficiency of experimental diets was calculated according to the local market prices of ingredients and rabbit live body weight as following:

Net revenue = total revenue – total feed cost.

Economical efficiency (%) = net revenue / total feed cost.

The obtained data were statistically analyzed using analysis of variance according to SAS [14] users guide (1998) and Duncan's (1955) new multiple range test were also carried out when ever necessary according to Snedecor and Cochran (1982).

Table (1) Percentage composition and chemical analysis of experimental diets

Ingredients	Olive cake meal replacement of clover hay at				
	0%	25%	50%	75%	100%
Barley	47.0	44.0	42.0	39.0	36.0
OKM	00.0	7.0	14.0	21.0	28.0
Clover hay	28.0	21.0	14.0	7.0	00.0
Sunflower meal	19.0	22.0	24.0	27.0	30.0
Molasses	2.0	2.0	2.0	2.0	2.0
Bon meal	2.8	2.8	2.8	2.8	2.8
Sodium Chloride	0.5	0.5	0.5	0.5	0.5
Vitamins and minerals mixture	0.5	0.5	0.5	0.5	0.5
DL-Methionine	0.1	0.1	0.1	0.1	0.1
L-Lysine	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100
Chemical analysis, %					
DM	93.44	93.76	92.50	92.54	91.92
OM	91.05	92.20	92.78	92.06	92.75
CP	16.72	16.69	16.65	16.85	17.03
CF	14.48	15.00	15.32	15.80	16.38
EE	1.70	3.52	4.34	5.61	6.88
NFE	58.15	56.99	56.47	53.80	52.46
Ash	8.95	7.80	7.22	7.94	7.25
Nutritive values					
TDN*	63.40	66.64	61.50	61.34	60.42
DE kcal/kg DM	2803	2934	2714	2707	2664
Cost of kg diet (L.E)	1.642	1.603	1.590	1.575	1.560

** Calculated according to digestibility trial*

Chemical composition of OKM 91.0, 93.05, 24.61, 18.27, 7.57, 42.60 and 6.95 for DM, OM, CP, CF, EE, NFE and ash respectively.

RESULTS AND DISCUSSION

Productive performance of growing NZW rabbits:

Biological performance of rabbits fed OKM has been shown in Table (2). It is worthy noting that all experimental rabbit have similar initial LBW at 5 weeks of age which ranged between 666.67 and 722.5g with no significant differences. Body weight (BW) increased with the OKM incorporation at 75% level

Table (2): Performance traits (Mean ± SE) of growing NZW rabbits fed on different levels of OKM as partial or complete substitute for clover hay

Item	Olive cake meal replacement of clover hay at				
	0%	25%	50%	75%	100%
Live weight (g) at:					
5 weeks	709.6 ± 21.22	722.5 ± 41.23	682.9 ± 40.33	725 ± 17.08	666.7 ± 38.28
7 weeks	1023 ± 68.94	1165 ± 58.79	983.3 ± 43.04	1158 ± 76.22	983.3 ± 76.87
9 weeks	1485 ± 83.51	1497 ± 94.27	1366 ± 63.76	1584 ± 83.93	1372.5 ± 75.09
11 weeks	1886^{ab} ± 88.94	1874^{b} ± 58.59	1632^{b} ± 34.64	1942^{a} ± 117.3	1794^{ab} ± 89.14
13 weeks	2145^{ab} ± 72.13	2134^{ab} ± 68.11	1919^{b} ± 35.91	2227^{a} ± 102	2052^{ab} ± 89.41
Daily weight gain (g)					
5-7 weeks	22.4 ± 2.15	31.61 ± 3.91	21.46 ± 1.68	30.95 ± 5.14	22.62 ± 3.04
7-9 weeks	33.04^{a} ± 1.43	23.69^{b} ± 1.67	27.32^{ab} ± 1.88	30.20^{ab} ± 3.76	27.80^{ab} ± 2.72
9-11 weeks	28.59 ± 2.32	26.97 ± 2.57	19.03 ± 4.39	25.54 ± 5.87	30.12 ± 1.55
11-13 weeks	18.45 ± 1.49	18.57 ± 2.21	20.49 ± 1.79	20.36 ± 6.04	18.39 ± 2.23
5-13 weeks	25.64 (100%)	25.21 (98.35%)	22.08 (86.12%)	26.82 (104.62%)	24.74 (96.48%)
Daily feed intake (g)					
5-7 weeks	76.69 ± 4.72	82.44 ± 0.73	77.04 ± 3.54	87.98 ± 4.45	85.72 ± 2.75
7-9 weeks	109.11^{a} ± 4.35	98.15^{b} ± 0.47	85.66^{c} ± 2.35	108.43^{a} ± 1.37	110.84^{a} ± 1.75
9-11 weeks	117.02 ± 5.04	124.13 ± 15.72	110.59 ± 4.78	120.54 ± 6.18	117.85 ± 5.87
11-13 weeks	103.22 ± 3.41	105.54 ± 0.83	101.22 ± 2.13	102.38 ± 1.07	105.54 ± 2.24
5-13 weeks	101.51 (100%)	102.57 (100.98%)	93.63 (92.18%)	104.84 (103.21%)	105 (103.36%)
Feed conversion (F/G)					
5-7 weeks	3.42^{b} ± 0.10	2.60^{a} + 0.35	3.59^{b} ± 0.13	2.84^{ab} ± 0.31	3.78^{ab} + 0.48
7-9 weeks	3.31^{ab} ± 0.16	4.14^{ab} + 0.41	3.14^{b} ± 0.23	3.56^{ab} ± 0.33	3.99^{a} + 0.75
9-11 weeks	4.09 ± 0.656	4.61 + 0.61	5.81 ± 0.91	4.72 ± 1.73	3.92 + 0.23
11-13 weeks	5.58 ± 0.56	5.68 + 0.99	4.94 ± 0.42	5.03 ± 1.34	5.74 + 0.72
5-13 weeks	4.10 (100%)	4.26 (103.9%)	4.32 (105.36%)	4.04 (98.54%)	4.36 (106.34%)
Mortality rate %					
5-13 weeks	0.00	0.00	8.30	0.00	0.00

a,, b and c: Means in the same row having different superscripts differ significantly (P<0.5).

(2227 ± 102) and was little higher than the other treatments will 25% and 100% incorporation, but it was significantly higher ($p < 0.05$) that 50% incorporation. It is worth noting that this trend was also noticed with the previous work of Ali (2010, under publication). Body weight with 75% OKM incorporation recorded 5.3% higher than that of the control group. Also, Kadi *et al.* (2004) found no significant differences on the main parameters of rabbit growth by using 61% of hard wheat bran and 20% of olive cake on their diets.

It is worthy that ADWG during the whole experimental periods (5-13 weeks) amounted 25.64, 25.21, 22.08, 26.82 and 24.74 g on diets with 0, 25, 50, 75 and 100% OKM incorporation showing that diet composition had no significant effect on BWG. The average growth rate of the present work is coincided with that which obtained by Berchiche *et al.* (2000), but higher than which obtained by Kadi *et al.* (2004).

It is worth while to note that OKM incorporation instead of CH in the control diet not cause bad effect on FI during the whole experimental period. Average daily feed intake (ADFI) during the whole experimental period (5-13 week) was 101.57, 102.57, 93.63, 104.84 and 104.99g for group 1, 2, 3, 4 and 5 respectively. On the contrary, Kadi et al. (2004) noticed that between 5 and 12 weeks, the feed intake was weak in feeding OKM up to 20% but significantly higher in the experimental group than in the control one (86.96 *VS* 77.57 g/d). This situation would be caused the high temperatures recorded in the region at the time of the test (37 C°).

The efficiency of food utilization during the whole experimental period was 4.10, 4.26, 4.32, 4.01 and 4.36 kg intake/ kg gain) for the experimental groups 1, 2, 3, 4 and 5 respectively, showing that group 4 was the most efficient one. Assuming the efficiency of control group equals 100 it would be 103.9, 105.3, 98.5 and 106.3% for groups 2, 3, 4 and 5 respectively indicating the superiority of 75% replacement of CH by OKM (1.46% lower than that of control group). It is worthy that Rupic *et al.* (1999) found also that rabbits fed on 10% olive cake, and particularly those consuming 20% of olive cake in their daily feed, manifested a better food conversion than rabbits in group whose fodder contained no olive cake. The present results show that it is possible to add OKM to growing rabbits as 75% replacement of CH without negative effect on their growth performance and feed efficiency. Also, Ahmed (1998) found that olive seed meal incorporation in broiler chicken ration up to 8% had no adverse effect on feed utilization. It is worthy that the mortality rate (MR) for the different treatments during the period 9-11 weeks of age did not exceed 8.3% when OKM replaced CH at a rate of 50%. Completely replacement of CH by OKM (group 5) did not record any death.

Carcass characteristics:

Warm carcass % without head dressed weight Table (3) was the highest (50.14%) in group 4 (75% OKM) , while that of completely replacement of CH by OKM recorded the lowest one (44.71%). The warm carcass % in the control group was intermediate (46.35%) the previous two values. These results are in good agreement with that obtained by Kadi *et al.* (2004) and Ghazala and El-Shahat (1994). It can be seen from data obtained in dressed weight, liver, kidney, heart or head weights that had no effect ($P>0.05$) in any one of these organs due to OKM levels. Significant differences were noticed only with offal's weight (blood, viscera, lung, skin, limb and tail) and edible interval organs (EIO) that includes (liver, heart and kidney). The offal's parts as percentage from that of pre-slaughter weight were the highest in nil OKM containing diet (control group) and in that of the highest level of OKM (completely replacement of CH by OKM), while those of 25, 50 or 75% replacement were intermediate.

It is worthy noting that EOW was the highest (6.35%0 when OKM completely replace CH but it was the lowest when it replaced 75% only (4.49%). No significant effects were noticed between the control group and that of replacing CH groups up to 75%.

Blood constituents:

The effect of OKM supplementation in the experimental diets of growing NZW rabbits on some blood constituents are tabulated in Table (4). The mean values of plasma glucose content obtained were 149 and 157 mg/100 ml for rabbits received tested OKM replacement level 75% and 100% respectively. These values were higher than those of the lower replacement. These results coincided with those of Rupic *et al.* (1999) who found that rabbits in groups fed on 10% and 20% dried olive cake had a similar, although slightly higher concentration of glucose in their serum than those in the control group. They noted that after 56 days of trial feed, different quantities (10 and 20%) and chemical compositions of dried olive cake did not influence the concentration of glucose in rabbit serum. Rabbits received tested OKM replacement level of 0, 25, 50, 75 and 100 % by CH in tested diets had no effect on plasma urea nitrogen (PUN) values.

The mean values of plasma creatinine were found to be 0.80, 0.90, 0.80, 0.90 and 0.90 mg/ 100ml for rabbits received tested OKM replacement levels of 0, 25, 50, 75 and 100 % of CH in tested diets respectively.

Table (3): Carcass characteristics for slaughtered rabbits as affected by different levels of OKM

Items	Olive cake meal replacement of clover hay at				
	0%	25%	50%	75%	100%
Live body weight (LBW), g	2232	2090	2000	2340	1683
Slaughter weight, g	2073^{ab}	2020^{ab}	1937^{ab}	2257^{a}	1640^{b}
%, of LBW	92.89	96.65	96.84	96.44	97.43
Dressed weight, g	1042^{ab}	1040^{ab}	992^{ab}	1173^{a}	753.3^{b}
% of LBW	46.35	49.69	49.59	50.14	44.71
Liver weight, g	78.34^{a}	75.00^{a}	70.00^{ab}	73.34^{a}	53.34^{b}
% of LBW	3.52	3.59	3.49	3.14	4.51
Kidney weight, g	23.34^{a}	25.00^{a}	20.00^{ab}	20.00^{ab}	13.34^{b}
%, of LBW	1.06	1.19	1.00	0.86	0.43
Heart weight, g	15.00	10.00	11.70	10.00	11.70
% of LBW	0.68	0.48	0.50	0.51	0.34
Head weight, g	128.34^{ab}	130.00^{ab}	126.66^{ab}	140.00^{a}	106.67^{b}
% of LBW	5.75	6.21	6.34	5.98	6.45
Offal's weight, g	945	810	782	922	747
% of LBW	42.66^{ab}	38.76^{b}	39.08^{b}	39.39^{b}	44.36^{a}
Edible organ weight, g	117^{a}	110^{ab}	100^{ab}	105^{ab}	76.67^{b}
% of LBW	5.25	5.26	4.99	4.49	6.35

a and b: Means in the same row having different superscripts differ significantly (P<0.5).
Offal's included blood, viscera, lungs, skin limbs and tail
Edible organ included liver, kidney and heart.

Table (4): Effect of feeding on blood constituents of the experimental groups

Items	Olive cake meal replacement of clover hay at					Normal
	0%	25%	50%	75%	100%	
GLU, mg/dl	114	131	119	149	157	85-140
BUN, mg/dl	14	11	14	21	14	10-35
CREA, mg/dl	0.80	0.90	0.80	0.90	0.90	1.0-1.9
TP, g/dl	6.70	6.10	6.20	6.70	6.20	5.5-7.5
GOT, U/L	59	58	57	64	83	35-80
GPT, U/L	73	84	91	60	104	22.37
ALP, U/L	279	220	174	159	149	50-136

GLU = Glucose BUN = blood urea nitrogen
CREA = Creatinine TP = Total protein
GOT = Glutamic oxalacetic tranaminase
GPT = Glutamic pyruvic tranaminase
ALP = Alkaline phosphatase

The plasma total protein (PTP) content irrespective of the OKM were within the normal range as shown in Table (4). Rupic *et al.* (1999) reported the concentration of proteins, their fractions and glucose in the serum of rabbits were not adversely affected by addition of 10% and 20% dried olive cake. They added that our values for total protein in the serum of rabbits from all the groups were similar to those found in healthy rabbits by Yu *et al.* (1979), Scheunert and Trautmann (1987), Bortolotti *et al.* (1989) and Lepitzki and Woolf (1991).

The mean values of plasma glutamic pyruvic trans aminase (GPT) were found to be 73, 84, 91, 60 and 104 U/ml for rabbits received tested OKM replacement level of 0, 25, 50, 75 and 100 % of CH in the tested diets respectively.

At last mean values of alkaline phosphatase (ALP) were found to be 279, 220, 174, 159 and 149 U/ ml for rabbits received tested OKM replacement of 0, 25, 50, 75 and 100 % of CH in the tested diets respectively. Values of ALP of all groups of OKM were lower than those of control one to conclude diets containing 7, 14, 21 and 28% of dried OKM caused no disorders in health state of rabbits.

Table (5): Apparent digestion coefficients and nutritive values (Mean ± SE) of the experimental diets

Item	Olive cake meal replacement of clover hay at				
	0%	25%	50%	75%	100%
Apparent digestion coefficients					
Dry matter (DM)	$69.52^{a} \pm 0.57$	$68.30^{a} \pm 1.01$	$66.48^{a} \pm 0.89$	$64.39^{ab} \pm 1.04$	$60.48^{b} \pm 1.11$
Organic matter (OM)	$84.26^{b} \pm 2.03$	$91.59^{a} \pm 0.13$	$90.53^{a} \pm 1.10$	$93.95^{a} \pm 1.04$	$91.95^{a} \pm 1.28$
Crude protein (CP)	$77.72^{a} \pm 1.97$	$74.45^{ab} \pm 1.13$	$72.52^{abc} \pm 0.38$	$69.88^{bc} \pm 2.69$	$66.96^{c} \pm 0.30$
Ether extract (EE)	$73.11^{c} \pm 1.98$	$78.17^{bc} \pm 1.97$	$85.96^{a} \pm 2.33$	$84.61^{ab} \pm 1.56$	$88.53^{a} \pm 3.44$
Crude fiber (CF)	$39.58^{a} \pm 2.04$	$37.83^{a} \pm 2.12$	$35.22^{a} \pm 2.81$	$28.95^{b} \pm 3.05$	$26.14^{b} \pm 0.54$
Nitrogen-free extract (NFE)	$78.88^{ab} \pm 7.21$	$82.83^{a} \pm 0.76$	$78.55^{ab} \pm 05.85$	$74.26^{bc} \pm 4.09$	$69.90^{c} \pm 2.01$
Nutritive values					
Digestible crude protein (DCP)	$12.99^{a} \pm 1.15$	$12.43^{ab} \pm 1.50$	$12.07^{ab} \pm 1.71$	$11.77^{b} \pm 1.88$	$11.40^{b} \pm 1.57$
Total digestible nutrients (TDN)	$63.40^{ab} \pm 3.00$	$66.64^{a} \pm 3.20$	$61.50^{b} \pm 2.50$	$61.34^{b} \pm 2.15$	$60.42^{b} \pm 3.15$
Digestible energy (DE), kcal	$2802^{ab} \pm 57.74$	$2934^{a} \pm 39.05$	$2714^{b} \pm 57.74$	$2707^{b} \pm 58.27$	$2664^{b} \pm 59.38$

a,, b and c: Means in the same row having different super scripts differ significantly (P<0.5).

Digestibility coefficients and nutritive values:

Significant differences among treatment groups were observed for the digestibility of DM, OM and CF, while it was highly significant for digestibility of CP, EE and NFE as shown in Table (5). The observed decreased in digestibility of CP and CF (in groups 4 & 5) may be attributed to the high lignin content of olive pulp and the fat that most of its total nitrogen is linked to ligno cellulose which are the two main factors limiting the digestive utilization of olive residues (Aguilera *et al.*, 1992). The present results obtained on nutrients digestibility of diets were supported with the findings of El-Kerdawy (1997) and Tortuero *et al.* (1989) who indicated that digestibility of CP, neutral and acid detergent fiber (NDF & ADF) were reduced with 30% olive pulp diet, however no changes were recorded with 10 or 12% OKM diet compared with control. Ben Ravana *et al.* (1994) reported a significant decreased in CP and CF digestibilities coefficients when rabbits were fed diet including 11.5% olive pulp (OP) however no significant difference were observed with rabbits fed diets included 0 or 23% OP. However Ghazalah and El-Shahat (1994) mentioned that digestibility of OM was not affected significantly by dietary inclusion of OKM up to 75% of barley while, it decrease ($P<0.05$) in rabbits received a diet in which OKM completely replaced barley.

Total digestible nutrient (TDN) and digestible crude protein (DCP) values decreased significantly as OKM inclusion rate were more than 50% of CH. The observed decrease in TDN or DCP which followed the increase in OKM inclusion may be attributed to depression in CP and CF digestibilities of OKM. It is worthy noting that Ghazalah and El-Shahat (1994) revealed also that feeding values of TDN, SV and DE decreased ($P<0.05$) by increasing dietary OKM more than 50% of barley. Also, El-Kerdawy (1997) found that DCP decreased significantly ($P<0.01$) as olive pulp inclusion rates were 10 or 15% of the diet.

Economic evaluation:

It is evident from Table (6) that the control CH diet was the highest in cost of 1.0 kg diet (1.642 L.E), while the cost of one kg of the experimental diets was decreased by increasing the inclusion of OKM to reach 1.560 L.E at 100% replacing.

Table (6) Net revenue and economic efficiency

Item	Olive cake meal replacement of clover hay at				
	0%	25%	50%	75%	100%
Marketing weight, Kg	2.15	2.13	1.92	2.23	2.05
Feed consumed / rabbit, kg	7.11	7.18	6.55	7.34	7.35
Costing of one kg feed, (LE)[1]	1.64	1.60	1.59	1.58	1.56
Total feed cost, (LE)	11.67	11.51	10.42	11.56	11.46
Management/ Rabbit, (LE)[2]	4	4	4	4	4
Total cost, (LE)[3]	30.67	30.51	29.42	30.56	30.46
Total revenue, (LE)[4]	42.9	42.68	38.38	44.54	41.04
Net revenue	12.23	12.17	8.96	13.98	10.58
Economical efficiency[5]	0.40	0.40	0.30	0.46	0.35
Relative economic efficiency[6]	100	100	76.3	114.7	87.0
Feed cost / kg LBW (LE)[7]	5.44	5.39	5.43	5.19	5.59

[1] *Based on prices of year 2008.*
[2] *Include medication, vaccines, sanitation and workers.*
[3] *include the feed cost of experimental rabbit which was LE 15/ rabbit + management.*
[4] *Body weight x price of one kg at selling which was LE 20.*
[5] *net revenue per unit of total cost.*
[6] *Assuming that the relative economic efficiency of control diet equal 100.*
[7] *Feed cost/kg LBW = feed intake * price of kg / Live weight.*

It is worth while to note that the diet in which OKM replaced 25 and 50% of CH recorded 2.4% and 3.3% lower in the cost of one kg diet respectively compared to the control diet, while that of diet 5 recorded 5.3%. The net revenue/ rabbit was 12.23, 12.17, 8.96, 13.98 and 10.58 L.E for groups 1, 2, 3, 4 and 5 respectively, showing that the net revenue per rabbit was the highest in group 4 (13.983 L.E) in which OKM replaced 75% of Ch followed by the control group (12.232 L.E) and that of group 2 in which OKM replaced 25% of CH.

The economical efficiency (EE) for group 1-5 was 0.339, 0.339, 0.305, 0.458 and 0.347 respectively, showing that EE was the highest with diet 75% OKM replacement of CH followed by that of diet 2 with 25% OKM replacement.

It is worthy noting that diet of group 4 (which OKM replaced 75% of CH) recorded the highest net revenue (NR) and economical efficiency (EE). It is evident that comparing data on the basic of NR or EE showed that group 4 in which OKM replaced 75% of CH was the most superior one.

CONCLUSION

It appears that the inclusion of OKM to replace 75% CH in rabbit diets is economically effective. Accordingly OKM as a cheaper agriculture-industrial by-products could be achieved without any harmful effect on growth, slaughter and feed utilization of NZW rabbits.

In Egypt conditions of rabbit production, the use of the available and low-cost agriculture by-products (olive cake and other cereal by-products) necessary to reduce the price of the feed that is one of the main obstacles to the development of the rabbit raising.

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دراسة تأثير إحلال كسب الزيتون محل دريس البرسيم فى مخاليط الأعلاف على أداء الأرانب النيوزيلاندى النامية

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استخدم فى هذه الدراسة عدد ستون أرنب ذكر نيوزيلاندى أبيض مفطومة عمر (4 أسابيع) وزعت على خمسة معاملات واحتوت كل معاملة على ثلاثة مكررات داخل كل مكررة أربعة أرانب ، وتم تسكين كل أرنب فى قفص على انفراد.

استهدفت هذه الدراسة تقييم كسب بذرة الزيتون بالإحلال الجزئى أو الكلى (صفر، 25، 50، 75، 100%) محل مسحوق دريس البرسيم فى عليقة الاختبار (العليقة القاعدية). تم دراسة مقاييس النمو وهى وزن الجسم الحى، الزيادة فى الوزن، معدل النمو، استهلاك الغذاء، كفاءة التحويل الغذائى كما أجريت اختبارات الذبح فى نهاية التجربة، وحسبت أيضا الكفاءة الاقتصادية للمنتج النهائى، كما تم أيضا التقييم الغذائى لهذه البدائل المختلفة من حيث التركيب الكيماوى ومعاملات الهضم للعلائق التجريبية المختلفة مع إيجاد القيمة الغذائية لمخاليط الأعلاف. أظهرت نتائج هذه الدراسة الخاصة بأداء الأرانب خلال فترة النمو مدعمة بمواصفات الذبيحة وتحليلات الدم ما يلى:

سجل وزن الجسم للأرانب المغذاه على عليقة تحتوى على 75% مسحوق كسب بذرة الزيتون 2.14% زيادة عن تلك الأرانب المغذاه على عليقة المقارنة الخالية من مادة الدراسة. و لم تؤثر نسب الإحلال المختلفة بكسب بذرة الزيتون بنسب (صفر، 25، 50، 75، 100%) محل مسحوق دريس البرسيم تأثيراً معنوياً على متوسطات الزيادة اليومية المكتسبة فى أوزان الأرانب خلال فترة التجربة (5-13 أسبوع). كما لم يؤثر الإحلال الكامل لمسحوق دريس البرسيم بكسب بذرة الزيتون على نسبة التصافى إلا أنه لوحظ اختلافات معنوية مع أوزان مخلفات الذبيحة Offal's (الدم ، الأحشاء ، الرئتين ، الجلد ، الأرجل ، الذيل) والأعضاء الصالحة للأكل (EOW). و حققت المجموعة الرابعة التى تم إحلال كسب بذرة الزيتون محل 75% من دريس البرسيم فى المخلوط الغذائى أعلى عائد صافى وكفاءة اقتصادية. و أوضحت الدراسة الخاصة أن معاملات الهضم والقيم الغذائية لعلائق الاختبار تأثر قيم كل من المركبات المهضومة الكلية (TDN) والبروتين المهضوم (DCP) معنوياً مع زيادة معدل إحلال كسب بذرة الزيتون، وقد يكون هذا التأثير لانخفاض معاملات هضم كل من البروتين والألياف بكسب الزيتون. و يوجد اختلافات معنوية عند مستوى المعنوية (0.05) بين مخاليط أعلاف المجموعات التجريبية لمعاملات هضم كل من المادة العضوية OM والبروتين الخام CP والدهن الخام EE والألياف الخام CF فقط والعكس بالعكس بالنسبة لمعاملات هضم الكربوهيدرات الذائبة NFE. و كانت القيم الغذائية وهى (البروتين المهضوم DCP ،المركبات الغذائية المهضومة الكلية TDN والطاقة المهضومة DE متشابهة تماماً مع زيادة مسحوق كسب الزيتون الغذائى فى علائق الأرانب حتى 75% بينما لوحظ وجود تأثير على هذه القيم الغذائية برفع مستوى الإحلال إلى 100%. كما لوحظ زيادة فى قيمة GPT, GOT وكذلك الجلوكوز فى المجموعات المغذاه على كسب بذرة الزيتون عن مجموعة المقارنة والعكس بالعكس بالنسبة لقيمة ALP.

وتشير هذه النتائج السابقة إلى إمكانية استعمال كسب بذرة الزيتون محل مسحوق الدريس فى تغذية الأرانب النامية حتى مستوى 75%.