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EFFECT OF FEEDING CANOLA MEAL ON PERFORMANCE OF BARKI LAMBS

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ABSTRACT

One hundred growing Barki lambs were randomly assigned to five comparative feeding trials (22.8, 22.8, 22.9, 22.7 and 22.9 ±1.011 Kg BW for groups 1, 2, 3, 4 and 5 respectively). The feeding experiments lasted for 140 days to evaluate the effect of protein replacement by canola meal protein at 0, 10, 20, 30 and 40% in five different concentrate feed mixtures (CFM), yet isonitrogenous and isocaloric on lamb growth performance and some rumen and blood parameters.the CFMs were fed at 2.5 % of body weight whereas rice straw was offered *ad. lib.* During the feeding experiments, five metabolism trials were carried out in order to evaluate the feeding values of the experimental rations. Results indicated that digestion coefficients of CP, EE and NFE, nutritive value as TDN, nitrogen retention, rumen parameters TVFA's, blood protein, daily gain and feed efficiency (Kg DM and TDN / Kg gain) were significantly increased ($p < 0.05$) with increasing canola meal level in rations. Digestion coefficients of DM and OM, nutritive value of DCP, DE and ME, blood albumin, globulin and total DM intake were not influenced by increasing the level of canola meal in rations. On the other hand, increasing the level of canola meal significantly ($P<0.05$) lowered digestion coefficient of CF, rumen pH, ammonia- N and blood serum urea nitrogen.

Conclusively, canola meal protein could economically replace up to 40% of total CP of CFM without any adverse effect on the performance of Barki lambs. These results may lead to that, canola meal should be given attention as a feed component to play an active role in the relief of the problem of protein shortage in Egypt. However, more studies are warranted with different ruminants in different stages of production.

Keywords: canola meal, lambs, metabolism, growth performance

INTRODUCTION

One of the most important factors affecting the improvement of animal production is the availability of good quality feedstuffs at low prices.

Rape is a plant that belongs to the cruciferae family. During recent years, the Canadian breeders introduced "canola" as a registered name for rapeseed containing less than two percent of the total fatty acid in the oil as erucic acid and less than 30 µmoles of alkenyl glucosinolates per gram (Bell, 1993 and Dessouky, 1996). Canola meal is a product of the crushing and oil extraction of canola seeds. It is an excellent source of protein for dairy cattle (Sanchez and Claypool, 1983), beef cattle (McKinnon *et. al.*, 1993) and lambs (Stanford *et. al.*, 1995, 1996 and Agbossamey *et. al.*, 1997). In general, canola meal is considered a highly digestible protein source (Stanford *et. al.*, 1995). In addition, Fan *et. al.* (1996) reported that canola meal could be an alternative to many protein supplements.

At present, canola seed is grown intensively in different areas in Egypt. It, therefore, may play an important role in narrowing the gap of protein in animals diets. This study was carried out to examine the effect of canola meal supplemental protein and fat on performance, diet digestibility and some rumen and blood parameters of growing Barki lambs.

MATERIAL AND METHODS

Animals and management.

The experiment was carried out using 100 Barki lambs (22.82 ±1.011 Kg average body weight) at the agro–industrial Compound, Horticulture Services Unit, Agricultural Research Center, North west of Egypt. Animals were randomly divided into five equal groups each of twenty lambs. The crude protein content of canola meal was found to be practically as twice as that of CFM (32.41 vs 15.65 %). The protein content of canola meal replaced CFM protein at 0, 10, 20, 30 and 40%. Canola meal at the specified levels was included on as feed ingredient in five concentrate feed mixtures. This nitrogenous replacement made up a proportional percentage of canola meal as a feed ingredient in CFM; that is 0, 5.1, 10.1, 15.2 and 20.3% of the total ingredients. Feed ingredients of the 5 experimental CFM are presented in Table (1). The daily amounts of CFM (2.5% of body weight) were offered in two equal portions at 8 a.m. and 16.00 p.m. Rice straw was used as roughage and offered *ad lib*. The residues from rice straw were daily weighed to calculate feed intakes. Fresh water was available at all times. The Feeding trial lasted for 140 days. Live body weight changes and feed intakes were recorded at weekly intervals. After ten weeks from the beginning of the experiment, five metabolism trials were conducted simultaneously using three randomly selected animals from each group. Animals were housed random in metabolic cages to determine the feeding values of the experimental rations. Animals were allowed 15 days to adapt to the cages. Feeds, feces and urine were collected during the collection week. At the last day of the collection period, rumen liquor was sampled by a stomach tube at zero and four hrs after feeding. Ruminal pH was determined immediately using a digital pH meter. The strained samples were immediately frozen at -20°c for later analysis. Blood samples were collected from the Jagular vein before feeding at the last day of the collection period. Blood serum was separated by centrifugation and kept frozen for later analysis.

Table (1) Different ingredients (%) of the experimental Concentrate Feed Mixtures (CFM)

Ingredient	CFM1	CFM2	CFM3	CFM4	CFM5
Yellow corn grains	50	50	50	50	50
Cotton seed meal	20	20	20	13	11
Linseed meal	18	12.9	7	6	4
Canola meal	0	5.1	10.1	15.2	20.3
Wheat bran	6	6	6.9	7.8	4.7
Cane molasses	3	3	3	5	7
Limestone	2	2	2	2	2
Salt	1	1	1	1	1
Total	100	100	100	100	100
TDN (calculated	70.07	70.22	70.33	70.59	70.76

Experimental rations

During the preparation of CFM, canola meal was added at 0, 5, 10, 15 and 20% of ingredients in order to make up the previously specified nitrogen replacements (0, 10, 20, 30 and 40%, respectively). The output was five different concentrate feed mixtures, yet isonitrogenous and isocaloric. Concentrate feed mixtures were fed at 2.5% of average body weight. The roughage portion of the rations was rice straw which was offered *ad lib* to animals.

Chemical analysis

Feeds, feces and urine were analyzed according to A. O. A. C. (1990). Fiber fractions of ration ingredients were analyzed according to Goering and Van Soest (1970). Gross energy (GE), digestible energy (DE) and metabolizable energy (ME) were calculated according to MAFF (1975). The chemical composition of experimental CFM's, canola meal and rice straw and calculated composition of consumed diets are presented in Table (2). Rumen fluid samples were analyzed for ammonia – N and total VFA's concentrations according to Conway (1962) and Kromman *et. al.*, (1967), respectively. Microbial nitrogen in the rumen in grams was calculated according to Czerkawski (1986) and ARC (1984). Blood serum total protein was determined by the method of Peters (1968) whereas albumin determination was carried out according to Drupt (1974) and urea nitrogen (Patton and Crouch, 1977) and globulin was obtained by subtracting the albumin value from total protein value.

Statistical analysis

The data were statistically analyzed using GLM procedures of SAS (1992).

RESULTS

Metabolism trials

Apparent OM digestibility coefficient slightly increased, while CP, EE and NFE digestibility coefficients increased gradually ($P<0.05$) as the inclusion level of canola meal increased in rations (Table 3 and Fig 1). In contrast, CF digestibility decreased ($P<0.05$). However, canola meal inclusion at any level had no effect on DM digestibility.

The nutritive values expressed as TDN tended to increase ($P< 0.05$) as canola percent increased in rations. The DCP, digestible energy (DE) and metabolizable energy (ME) were not affected by increasing level of canola meal in rations.

Results presented in Table (4) revealed that, absolute values of nitrogen balance and nitrogen balance as percent of nitrogen intake or digested nitrogen increased significantly ($P<0.05$) as the level of canola meal increased.

The average values of rumen liquor parameters (ruminal pH values, total VFA's and ammonia-N concentrations) at zero time were similar (Table

Table (2) Chemical composition of ingredients and calculated rations

Items	DM	OM	CP	CF	EE	Ash	NFE	NDF	ADF	ADL	Hemi-cell.	Cell.	GE,MJ/KgDM
DM basis %													
Canola meal	89.11	94.22	32.41	16.74	10.11	5.78	34.96						
Rice straw	89.74	86.48	4.21	33.21	1.21	13.52	47.85	73.01	46.25	4.48	26.76	41.77	16.28
CFM 1	89.69	93.15	15.65	8.35	2.68	6.85	66.47	30.83	14.28	2.41	16.55	11.87	18.00
CFM 2	89.55	93.16	15.75	8.68	3.05	6.84	65.68	31.80	14.40	2.52	17.40	11.78	18.09
CFM 3	89.80	93.17	15.72	9.03	3.40	6.83	65.02	31.60	14.23	2.62	17.37	11.71	18.18
CFM 4	89.62	93.10	15.63	8.26	3.85	6.90	65.36	30.69	14.09	2.63	16.60	11.46	18.25
CFM 5	89.51	93.04	15.85	8.11	4.18	6.96	64.90	30.14	14.00	2.92	16.14	11.08	18.33
Calculated chemical composition of consumed tested rations.													
R 1	89.65	90.83	11.67	16.99	2.17	9.17	60.00	45.50	25.40				17.40
R 2	89.62	90.67	11.45	17.83	2.36	9.33	59.03	47.17	26.28				17.41
R 3	89.79	90.74	11.54	17.82	2.60	9.26	58.78	46.66	25.87				17.49
R 4	89.67	90.70	11.50	17.29	2.89	9.30	59.02	46.34	25.73				17.54
R 5	89.69	90.76	11.80	16.85	3.14	9.24	58.97	45.07	25.23				17.62

Table (3) Mean values of nutrients digestibilities and nutritive value recorded with lambs given rations containing CFM + R. S.

Items	Nutrient digestibility %						Nutritive value			
	DM	OM	CP	CF	EE	NFE	TDN%	DCP%	DE,MJ/ Kg DM	ME,MJ/ Kg DM
Group 1	65.09	68.00	64.63^{b}	56.44^{a}	70.89^{c}	71.80^{b}	63.37^{b}	7.54	11.73	9.62
2	65.49	68.13	66.00^{ab}	55.74^{b}	72.44^{bc}	72.09^{ab}	63.55^{b}	7.56	11.74	9.63
3	65.30	68.37	66.29^{ab}	55.28^{b}	73.46^{b}	72.52^{a}	64.03^{ab}	7.65	11.79	9.67
4	65.36	68.45	66.71^{ab}	54.37^{c}	74.46^{ab}	72.62^{a}	64.33^{a}	7.67	11.80	9.68
5	65.30	68.60	67.05^{a}	53.74^{c}	76.13^{a}	72.75^{a}	64.81^{a}	7.91	11.83	9.70
±SE	0.787	0.684	0.977	0.719	0.601	0.731	0.667	0.153	0.123	0.102

a ,b and c means in the same column with different superscripts are significantly different ($p < 0.05$).

5). At four hrs post feeding, ruminal pH values and ammonia-N concentrations decreased (P<0.05) while TVFA's concentrations increased (P<0.05) with increasing proportions of canola meal in rations. Yields of microbial N synthesis (g/day) of the five rations were similar.

The average values of blood serum total protein concentration (Table 6) increased significantly (P<0.05) when percentage of canola meal in diets increased. On the other hand, serum albumin and globulin concentrations were not affected by level of canola meal in rations. Animal groups fed canola meal (2 to 5) showed lower (P<0.05) urea concentrations than the control group.

Figure 1. Effect of canola level on digestibilty coefficients of CP, NFE, and EE

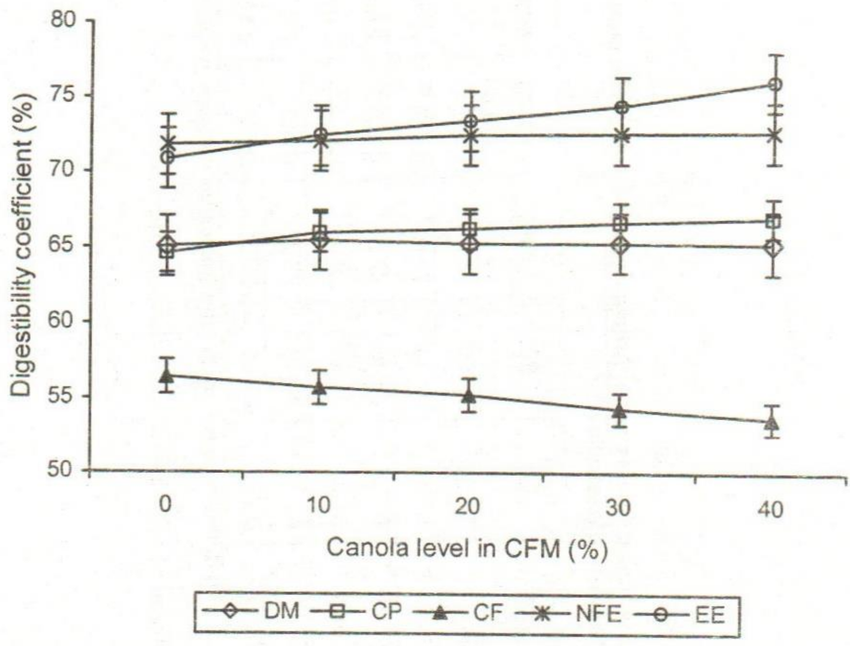


Table (4) Nitrogen utilization by lambs fed the experimental diets.

Items	Experimental diets					
	1	2	3	4	5	±SE
N. Intake g / h	20.33	19.84	19.54	19.17	19.30	
Fecal N. g/ h	7.19	6.75	6.59	6.38	6.36	
Digested N. g/ h	13.14	13.09	12.95	12.79	12.94	
Urinary N. g/ h	8.14	7.99	7.76	7.51	7.53	
N. balance g/ h	5.00^{d}	5.10^{cd}	5.19^{bc}	5.28^{ab}	5.41^{a}	0.048
NB. of NI. %	24.59^{d}	25.71^{cd}	26.56^{bc}	27.54^{ab}	28.03^{a}	0.134
NB of DN. %	38.05^{c}	38.96^{c}	40.08^{b}	41.28^{a}	41.81^{a}	0.176

a, b, c and d means with different superscripts in the same row are significantly different ($p < 0.05$).

Table (5) Ruminal characteristics of lambs fed rations containing CFM and rice straw

Items	PH value		TVFA's Meq / 100 ml.		Ammonia N. Mg / 100 ml.		Microbial N-synthesis G / day
	Time after feeding (hr)						
groups	0	4	0	4	0	4	
1	6.90	6.22 [a]	5.87	8.77 [b]	10.08	15.60 [a]	7.75
2	6.91	6.19 [ab]	5.77	8.86 [ab]	10.05	15.49 [a]	7.75
3	6.92	6.17 [ab]	5.76	8.95 [ab]	10.10	15.38 [ab]	7.78
4	6.90	6.14 [ab]	5.87	9.06 a	10.08	15.28 [ab]	7.79
5	6.91	6.12 [b]	5.76	9.13 [a]	10.07	15.00 [b]	7.81
±SE	0.026	0.022	0.152	0.050	0.128	0.110	0.063

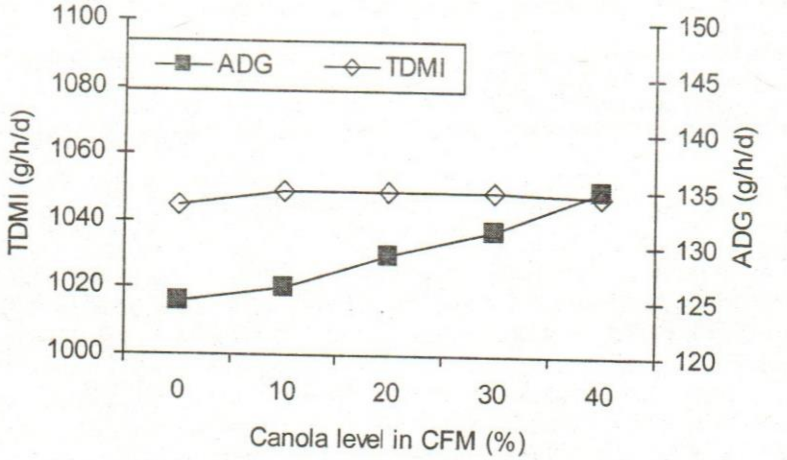
a and b means with different superscripts in the same column are significantly different ($p < 0.05$).

Table (6) Effect of feeding the experimental rations on some blood serum parameters of lambs.

items	Nitrogen metabolism			
	TP (gram %)	AL (gram %)	GL (gram %)	Urea (milligram %)
Group 1	6.85 [b]	3.84	3.01	20.23 [a]
2	6.88 [ab]	3.85	3.03	19.90 [ab]
3	7.01 [ab]	3.87	3.14	19.65 [ab]
4	7.05 [a]	3.88	3.17	19.49 [b]
5	7.06 [a]	3.87	3.19	19.38 [b]
±SE	0.067	0.046	0.085	0.022

a and b means with different superscripts in the same column are significantly different ($p < 0.05$).

Figure 2. Effect of canola level on TDMI and ADG of growing sheep



Growth trials

Growth performance data are present in Table (7) and Figure (2). Daily gain and feed efficiency (Kg DM and TDN/Kg gain) were improved (P<0.05) with increasing the level of canola meal in the experimental rations. However, no significant effect was found of level of canola meal on TDMI as percent of live body weight, TDNI, DCPI (g/h/d) and feed conversion (Kg DCP/Kg gain).

On the other hand, improvement of cost per Kg gain (LE) and economical efficiency were found with increasing canola meal in rations.

Table (7) Performance of lambs fed the different experimental rations.

Items	G1	G2	G3	G4	G5	±SE
Initial weight (Kg)	22.80	22.80	22.90	22.70	22.90	1.011
Final weight (Kg)	40.27	40.45	40.96	41.08	41.78	
Total gain (Kg)	17.47	17.65	18.06	18.38	18.88	
Daily gain (g/h/d)	124.79[b]	126.07[ab]	129.00[a]	131.29[a]	134.86[a]	0.132
Daily feed intake (g /h /d)						
CFM	681	685	688	690	693	
R.S	364	364	361	359	355	
CFM : R.S	1.87	1.88	1.91	1.92	1.95	
TDMI	1045	1049	1049	1049	1048	86.304
TDNI	662	667	672	675	679	54.617
DCPI	79	79	80	80	83	6.119
TDMI of body weight %	3.31	3.32	3.29	3.29	3.24	0.091
Feed conversion						
Kg DM / Kg gain	8.37[a]	8.32[a]	8.13[ab]	7.99[ab]	7.77[b]	0.568
Kg TDN / Kg gain	5.30[a]	5.29[a]	5.21[ab]	5.14[ab]	5.03[b]	0.334
Kg DCP / Kg gain	0.63	0.63	0.62	0.61	0.62	0.038
Cost / Kg gain*	5.64	5.52	5.36	5.16	5.01	
Cost / Kg gain improving %		2.13	4.96	8.51	11.17	
Economical efficiency**	2.53	2.59	2.67	2.77	2.85	
Economical efficiency Improvement, %		2.37	5.53	9.49	12.65	

a and b means with different superscripts in the same row are significantly different (p<0.05).

***Based on the assumption that the price of one ton, of CFM1, CFM2, CFM3, CFM4, CFM5 and rice straw are 610, 605, 600, 585, 580 and 60 L.E, respectively. The price of one Kg live body weight gain was 10.00 L.E**

****The ratio between the price of the weight gain and cost of feed consumed.**

DISCUSSION

In general, chemical composition of CFM and rice straw (RS) (Table 2) were within the ranges reported by other investigators (Bell and Keith,1991; Bell, 1993; Fan *et al,* 1996; Mustafa *et al,* 1996; Mehrez et al 2001 and Fouad *et al,* 2002).

Chemical composition of the complete diets consumed in the five digestibility trials (Table 2) showed that they were slightly different. However, EE (% of DM) and gross energy (MJ/Kg DM) contents of the total mixed diets increased gradually with increasing level of canola meal in CFM. This might be a result of high EE content of canola meal (10.11%). The range of EE content of the complete diets fed was 2.17 – 3.14%, which would represent good quality diets. Ørskov and Ryle (1990) reported that dietary fat levels in excess of 7% are known to inhibit feed intake.

On the other hand, the range of NDF in the rations was 45.07–47.17% which would also represent good quality diets. The level of NDF in the tested rations should not limit the intake or cause insufficient feed utilization since the concentration of NDF less than 60% should not affect intake or digestibility of feeds (Vas Soest, 1965).

Digestibility coefficients, and nutritive values of the rations prevented in Table (3), showed that canola meal had no effect on DM and OM digestibilities. These results are in agreement with those obtained by Agbossamey *et al,* (1997) and Hussein *et al,* (1995) who found that apparent and true OM digestion in the stomach were not influenced ($P<0.05$) by dietary canola meal supplementation.

Excess heating during processing of the meal can cause the formation of Maillard products which is known to reduce degradation in the rumen (Broderick et al 1991). The canola meal used in this study was subjected to heat processing at 100°C for 1 hr. McAllister et al (1993), Subuh *et al,* (1994) and Stanford *et al,* (1995), found that excess heating of canola resulted in increased rumen undegradability of proteins. The supplementation of canola meal in rations (2 to 5) caused significant ($P<0.05$) increase in CP digestibility than that of control ration. Therefore, the improved protein digestion in the present study can be attributed to the effect of meal heating. In addition, the increased CP digestion could be explained by the fact that canola meal supplementation in rations resulted in greater crude protein flow to duodenum than linseed meal (Robinson *et al,* 1995) or soybean meal (Lardy *et al,* 1993) and that canola meal protein is a good source of truly available amino acids (91% true availability) (Barbour and Sim, 1991) and sulfur amino acids (Bell, 1984 and Khorasani *et al,* 1990).

Results in Table (3) and Figure (1) indicated that, digestion of EE and CF were inversely been affected ($P<0.05$) by canola meal supplementation. Ether extract digestibility increased while CF digestibility decreased with increasing the level of canola meal in rations. The higher apparent EE digestibility is mainly due to the smaller effect of endogenous lipid excretion on apparent fat digestibility because of the increased crude fat consumption and supplementation with highly digestible fat. Similar results were found by Palmquist, (1991) and Bendary *et al,* (1994). Decreased apparent CF digestibility may be associated with increased levels of fat through increasing canola meal level in rations (Table2).This observation might be a result of the decreases in ruminal digestion of NDF and ADF that were associated with reduced activities of fiber degrading enzymes in ruminal digesta (Hussein *et al,* 1995). The modification of ruminal fiber degrading microbial population due to fat supplementation was illustrated by Devendra and Lewis, (1974) and MacZulak *et al,* (1981) who indicated that growth of three of the major fiber degrading bacterial species was inhibited by increasing fat in rations. The inhibition of microbial activity from surface active long chain fatty acids

(LCFA) on cell membranes was illustrated by the absorption of fat by bacterial cell surfaces (Bauchart *et al,* 1990) and the decrease in secretion or activity of the extra cellular enzymes that degrade fiber (Tesfa, 1992). Also, similar decreased fiber digestion with increased levels of fat through increased canola meal level in ration was reported by Murphy *et. al.* (1987), Doreau *et. al.* (1991), Ferlay and Doreau (1992), Ferly *et. al.* (1992) and Tesfa, (1993).

The higher TDN values of canola meal rations (Table 3) are related to the higher digestibility of EE and NFE. In addition, the DCP values of canola meal rations were slightly higher than that of the control ration. This could be explained by the high CP digestibility values.

On the other hand, daily GE intake (Table 2) was not affected by canola meal supplementation, Moreover, there were no pronounced differences in digestible energy (DE) and metabolizable energy (ME) values among all tested rations indicating that the four groups utilized canola rations efficiently as those given the traditional CFM in control ration. Similar results were observed by Hussein *et al,* (1995) and Mustafa *et al,* (1996). In general, increasing the canola meal proportion resulted in increasing digestibilities of OM, CP, EE and NFE. These might also be attributed to that canola meal is a good source of phosphorus, calcium, magnesium, zinc, copper and manganese as reported by (Clandinin, 1989). This has resulted in increases in the activity of carbohydrates, fats and protein enzymes (Banerjee, 1988). This subsequently improved the nutritive values expressed as TDN and DCP (Taie, 1988), and may have been due to a higher fermentation rate and better ruminal activity (Bartocci *et. al.,* 1992 and Fouad, 2001a).

Nitrogen balance was significantly low ($P<0.05$) for the control ration (Table 4) because of increased urinary nitrogen output (8.14 g/h/d). On the other hand, the increases in N balance ($P<0.05$) with other rations (containing canola meal) may have been due to the improvement of nutrient digestibility (Table 3), and NH_3–N concentration (Table 5) and may also be due to the increased protein reaching the abomasum (Fouad and Deraz, 2002)) leading to increased microbial protein synthesis (Table 5) (El–Bedawy *et al,* 1993). Similar improvement was obtained in N balance as percentage of N intake and N digested (Table 4). The increase in N balance as the level of canola meal increased in rations is in agreement with other investigators (Stanford *et al,* 1995 and 1996) who reported a trend towards increased N balance for canola meal rations as compared with soybean meal rations.

In Table (5), at four hrs post feeding, ruminal pH and concentrations of NH_3–N decreased ($P<0.05$) while TVFA's concentrations increased ($P<0.05$) gradually when lambs were fed CFM containing increased canola meal levels than control CFM. Hussein et al (1995), reported increases in total VFA's production in rumen of steers fed canola meal.

It is of interest to note that, the recorded pH values were within the reported range for normal rumen function (Abou – Akkada and Blackburn, 1963). Minimum pH values were noticed at 4 hrs post feeding (Table 5) which were negatively interrelated with highest total VFA's concentrations (Gabr *et al,* 2001). These results were in agreement with those of Khorasani *et al,* (1992) and Doreau *et al,* (1993).

Canola meal used in this study was subjected to high heat during processing which resulted in increasing the rumen undegradable protein. Ammonia–N concentration decreased (P<0.05) gradually with lambs were fed rations 2 to 5,. Zerbini *et al,* (1988), reported that decreased CP degradability would result in lower ruminal ammonia – N concentration.

No negative effects was found of canola meal in rations on microbial N synthesis (g/d) in the present study (Table 5). This can be attributed to the effect o f h eating. Veen, (1986), speculated that slowly fermented protein in rumen and the resultant gradual release of ammonia–N, peptides and branched-chain fatty acids, promoted the availability of these essential growth factors to micro flora. Leng and Nolan, (1984) reported that levels of ammonia–N considered optimal for microbial synthesis range from 5 to 29 mg N/100ml of rumen fluid. The peak NH_3–N concentration recorded (15.35 mg/100 ml rumen liquor, (Table 5) as an average of tested diets, that would satisfy microbial needs for N and, hence, maximize rate of fermentation and synthesis of microbial protein in the rumen (Mehrez, 1992). On the other hand, a verage o f microbial nitrogen (g /d) in the present study agreed well with the findings of Borhami and Yacout (2001), Soliman et al (2001) and Bechai, (2001) in sheep fed diets containing different protein sources.

Data presented in Table (6) showed that blood serum total protein concentrations increased (P<0.05) and serum albumin and globulin concentrations slightly increased when percentage of canola meal in rations increased compared with control group. The increase in these parameters may be attributed to the increase of digestibility coefficient (Table 3) (Fouad 2001b), improved nitrogen absorption (Kornegay *et al,* 1997) increased amino acids synthesis in the liver (Moonsie–Shageer and Mowat, 1993) and improved immunity function (Habeeb *et al,* 2001). Generally, values of serum total protein and its fractions were in the normal range recorded by El–Reweny (1999) and William (1997) who reported that the normal blood of sheep has a range of 6 to 8 gm/100 ml for protein values.

On the other hand, blood urea nitrogen (mg %) can be used as an indicator of the amount of CP degraded in the rumen, since excess ruminal ammonia e nters t he b lood s tream (Beaulieu *e t a l*, 1 990). T he c anola m eal rations (2 to 5) were found to have lower (P<0.05) ruminal ammonia–N concentrations than the control ration (Table 5), which might explain the lower (P<0.05) level of serum urea nitrogen (Table 6). Similar results were reported by Mustafa *et al,* (1996), who found that blood urea nitrogen was lower (P<0.05) with animals fed canola meal diets than with those fed the soybean meal diets.

Animal performance is present in Table (7). Total DMI as a percentage of body weight were not affected by dietary protein source. This is in agreement with Hussein *et. al.* (1995), who reported that DM intake (Kg/h/d) was not affected by canola meal supplement in diets. Results also showed slight variation for concentrate: roughage ratio in the five rations. Mehrez, *et. al.* (1993), found that when the CFM level increased in the ration, the DM intake from roughage decreased.

The results (Table 7) also revealed an increase (P<0.05) in average daily gain and feed efficiency as (Kg DM and TDN/Kg gain) was significantly improved with increasing canola meal proportion in rations of Barki lambs during the growth period (140 day). The improvement in lamb performance was attributed to result of decreased ruminal CP degradability (Helene *et. al.* 1997), increased incorporation and utilization of amino acids and nuclear protein synthesis (Weser and Koolman, 1969) and increased nitrogen retention (Kornegay *et. al.* 1997). In addition, average values of some blood parameters o btained (Table 6) were within the range of normal values and might indicate that liver, kidney, spleen and muscles were functioning well (Fouad and Deraz, 2002).

These results are in agreement with those of other authors. Stanford (1995 and 1996), reported that average daily gain was greater ($P<0.05$) for lambs fed canola meal than for those fed soybean meal or sweet white lupine seed. Agbossamey *et al,* (1997), found that supplementation of diets with canola meal improved daily gain and feed efficiency of growing lambs.

On the other hand, the overall average daily gain for Barki lambs in the present study (129.20 g/h/d) was comparable with those reported by other investigators when Barki lambs were fed rations containing CFM and roughages. Etman and Soliman, (1999), Bechi, (2001) Lashien *et al,* (2001), Fahmy *e t a l,* (2001) and El-Badawy *et. al.* (2001), they reported, 129, 106, 113, 126 and 128 g/h/d, respectively for Barki sheep.

Data in Table (7) also showed that improvements in cost per Kg gain was 2.13, 4.96, 8.51 and 11.17%, respectively and economical efficiency were 2.37, 5.53, 9.49 and 12.65%, respectively with increasing canola meal percentage in tested rations (2 to 5) than control ration. Better feed conversion, in terms of Kg DM and TDN / Kg gain was associated with increased average daily gain which was in favour of using canola meal in rations for growing lambs.

CONCLUSION

It could be concluded that, under the circumstances of this study, canola meal protein could economically replace up to 40% of total CP of CFM without negative effects on feed intake, ruminal fermentation, daily gain and feed efficiency of growing Barki lambs. Moreover since the actual market price of canola meal is less than that of cotton seed meal or linseed meal, its use in animal feeding is recommended. However, the need for further studies to, fully characterize canola meal, as an animal feed during different physiological stats is evident.

REFERENCES

Abou- Akkada, A. R. and T. H. Blackburn (1963). Some observations on the nitrogen m etabolism o f r umen proteolytic bacteria. J. Gen. Microbiol., 3:461.

Agbossamey, Y. R., H. V. Petit, J. R. Seoane and G. J. Laurent. (1997). Performance of lambs fed either hay or silage supplemented with canola or fishmeals. Can. J. Anim. Sci., 77:135.

A.O.A.C. (1990). Official Methods of Analysis. 15^{th} ED. Association of Official Agricultural Chemists. Wash., D. C., USA.

ARC (1984). The Nutrient Requirements, of Ruminant Livestock. Suppl. No. 1. Common Wealth Agricultural Bureaux. Farnham Royal, England.

Banerjee, G. C. (1988). Feeds and Principles of Animal Nutrition 2^{nd} Ed. D. X. Ford and IBH publ. Co. PVT. LTD, p.636.

Barabour, G. W. and J. S. Sim. (1991). True metabolizable energy and true amino acid availability in canola and flax products for poultry. Poult. Sci., 70 : 2154.

Bartocci, S.; M. Verna; A. Amici and A. Agostin (1992). In vivo digestibility in buffaloes using diets with various energetic concentrations. Int'l symp. on Prospects of Buffalo Production in the Mediterranean/ Middle East. Cairo, Nov. 1992.

Bauchart, D.; F. Legay – Carmier; M. Doreau and B. Gaillard. (1990). Lipid metabolism of liquid – associated and solid – adherent bacteria in rumen contents of dairy cows offered lipid – supplemented diets. Br. J. Nutr. 63 : 563.

Beaulieu, A. D.; J. A. Olobobokun, and D. A. Christensen (1990). The utilization of canola and its constituents by lactating dairy cows. Anim. Feed Sci. Technol, 30: 289.

Bechai, A. A. (2001). Utilization of non- protein nitrogenous sources in animal feeding. Ph. D. Thesis, Fac. Agric. Moshtohor. Zagazig Univ. Egypt.

Bell, J. M. (1984). Nutrients and toxicants in rapeseed meal. A review. J. Anim. Sci., 58 : 996.

Bell. J.M. (1993). Factors affecting the nutritional value of canola meal: A review.Can. J. Anim.sci., 73:679.

Bell, J. M. and M.O. Keith (1991). A survey of variation in the chemical composition of commercial canola meal produced in Western Canadian crushing plants.Can. J. Anim. Sci., 71: 469.

Bendary, M. M.; I. A. Abou-Selim; M. R. M. Moustafa; A. M. Mahmoud and A. E. M. Khinizy. (1994). Performance of fattening buffalo calves fed different lavels of fat for two different periods. Egypt. J. Anim. Prod., 31 : 613.

Borhami, B. E. A. and M. H. M. Yacout (2001). Is the animal protein essential for better utilization of plant protein in ruminant. Egypt. J. Nut. &Feeds. 4: 25.

Broderick, G. A., R. J. Wallace, and E. R. Ørskov. (1991). Control of rate and extent of protein degradation. In T. Tsuda, Y. Sasaki, and R. Kawashima (Ed). Physiological Aspects of Digestion and Metabolism in Ruminants. Proc. Of the 7^{th} Int. Symp. on Ruminant Physiol. P. 558. Academic press, Can Diego. CA.

Clandinin, D. R. (1989). Canola meal for livestock and poultry. Canola Council of Canada, Winnipeg. M. B. Canada.

Conway, E. F. (1962). Microdiffusion Analysis and Volumetric Error. Rev. Edt. Lockwood. London, UK.

Czerkawaski, J. W. (1986). An Introduction to Rumen Studies. Pergamon Press. Oxford & New York.

Dessouky, M. S. (1996). Nutritional studies on rapseeds and sunflower seeds as feedstuffs in broiler rations. Ph. D. Thesis, Fac. Agric. Al-Azhar Univ. Cairo.

Devendra, C. and D. Lewis. (1974). The interaction between dietary lipids and fiber in the sheep. 2. Digestibility studies. Anim. Prod.,19 : 67.

Doreau, M.; A. Ferlay, and Y. El- meddah. (1993). Organic matter and nitrogen digestion by dairy cows fed calcium salts of rapeseed oil fatty acids or rapeseed oil. J. Anim. Sci., 71:499.

Doreau, M.; F. Legay, and D. Bauchart. (1991). Effect of source and level of supplemental fat on total and ruminal organic matter and nitrogen digestion in dairy cows. J. Dairy Sci., 74 : 2233.

Drupt, E. (1974). Colorimetric determination of albumin. Biol., J. 9:977.

El- Badawi, A. Y.; M. H. M. Yacout; H. M. Gado; A. Abdel – Basit and H. E. M. Kamel. (2001). Effect of the degree of sunchrony between carbohydrate and protein sources on utilization of rations by growing sheep. Egypt. J. Nut. And Feeds., 4: 63.

El- Bedawy, T. M.; A. Y. El- Badawi; S. M. Ahmed and E. A. Gihad. (1993). Effect of dietary protein level on nutrient utilization, rumen fermentation and composition of body weigh change of Rahmany sheep and Zaraibi goats. Egypt. J. Anim. Prod., 30:251.

El-Reweny, A. M. (1999). Studies on evaluation of feedstuffs, performance of lambs fed on total mixed rations containing formaldehyde treated soybean or linseed meal. M. Sc. Thesis. Fac. Agric. Mansoura Univ. Egypt.

Etman, K. E. I. and E. S. Soliman (1999). Effect of feeding peanut *(Arachis hypogaeal)* tops with different levels of concentrates on performance of growing lambs. Egypt. J. Nut. and Feeds, 2: 223.

Fahmy, A. A.; S. A. Attia Ismail and Afaf M. Fayed. (2001). Effect of monensin on salt plants utilization and sheep performance. Egypt. J. Nut. and Feeds, 4: 581.

Fan, M. Z.; W. C. Sauer and V. M. Gabert. (1996). Variability of apparent ileal amino acid digestibility in canola meal for growing – finishing pigs. Can. J. Anim. Sci, 76 :135.

Ferlay, A. and M. Doreau. (1992). Influence of mathod of administration of rapeseed oil in dairy cows. 1 – Digestion of nonlipid components. J. Dairy Sci., 75 : 3020.

Ferlay, A.; F. Legay; D. Bauchart; C. Poncet and M. Doreau. (1992). Effect of a supply of raw or extracted rapeseeds on digestion in dairy cows. J. Anim. Sci., 70 : 915.

Fouad, R. T. (2001 a). A comparative study on the performance of baladi cow calves and buffalo calves fed different levels of concentrates. J. Agric.Sci. Mansoura Univ., 26 (12): 7607.

Fouad, R. T. (2001 b). Effect of replacing concentrate feed mixture by barley grains on se'edi lambs performance in Upper Egypt. J. Agric. Sci. Mansoura Univ., 26 (12) : 7619.

Fouad, R. T.; and T. A. Deraz,(2002). Evaluation of different feeding systems for growing baladi lambs during summer. J. Agric. Sci. Mansoura Univ., 27 (7) 4539.

Fouad, R. T., T. A. Deraz and S. A. Attia. Ismail. (2002). A feeding strategy of lambs to increase nutrient utilization and reduce feed cost. J. Agric. Sci. Mansoura, Univ., 27 (3) : 1392.

Gabr, A. A.; A. Z. Mehrez; A. M. Abd El-Khabir; A. A. Abdel- Aziz and O. A. El- Zalaky. (2001). Performance and some blood plasma constituents of lactating goats fed diets containing formaldehyde treated dried poultry manure. Egyptian J. Nut. & Feeds.,4: 47.

Goering, H. K. and P. J. Van Soest (1970). Forage Fiber Analysis (Apparatus, Reagents, Procedures and Some Applications) USDA Handbook 379. Washington, D. C. USA.

Habeeb, A. A. M.; A. E. B. Zeidan and A. A. Shitta. (2001). The role of niacin and sprinkling in improving milk yield, composition and biochemical functions of the heat stressed Friesian cows. Egypt J. Nut. and Feeds, 4:285.

Helene, V. Petit, Romain Riox. P. S. D' Oliveria and I. N. do Prado (1997). Performance o f g rowing l ambs f ed g rass s ilage w ith row or extruded soybean or canola seeds Can. J. Anim. Sci., 77: 455.

Hussein, H. S., N. R. Merchen, and G. C. Fahey,Jr (1995). Effects of forage level and canola seed supplementation on site and extent of digestion of organic matter, carbohydrates and energy by steers. J. Anim. Sci., 73 : 2458.

Khorasani, G. R. ; G. de Boer; P. H. Robinson and J. J. Kennelly (1992). Effect of canola fat or ruminal and total tract digestion, plasma hormones and metabolites in lactating dairy cows. J. Dairy Sci., 75:492.

Khorasani, G. R.; W. C. Sauer; L. Ozimek and J. J. Kennelly. (1990). Digestion of soybean meal and canola meal protein and amino acids in the digestive tract of young ruminants. J. Anim. Sci., 68 :3421.

Kornegay, E. T.; Z. Wang; C. M. Wood and M. D. Lindemann (1997). Supplemental chromium picolinate influences nitrogen balance, dry matter digestibility and carcass traits in growing – finishing pigs. J. of Anim. Sci., 75: 1319.

Kromman, R. P.; H. J. Meyer, and W. J. Stielau. (1967). Steem distillation of volatile fatty acids in rumen digesta. J. Dairy Sci., 50:73.

Lardy, G. P.; G. E. Catlett, M. S. Kerly, and J. A. Paterson. (1993). Determination of the ruminal escape value and duodenal amino acid flow of rapeseed meal. J. Anim. Sci., 71 : 3096.

Lashien, M. E.; E. A. Saad; E. A. Helali and O. M. Abdel- Salam. (2001). Feeding studies on lambs in Upper Egypt. Egypt. J. Nut. and Feeds., 4: 529.

Leng, R. A. and J. V. Nolan (1984). Protein nutrition of the lactating dairy cow. Nitrogen metabolism in the rumen. J. Dairy Sci., 64: 1070.

MacZulak, A. E.; B. A. Dehority and D. L. Palmquist. (1981). Effects of long – chain fatty acids on growth of rumen bacteria. Appl. Environ. Microbiol., 42 : 856.

MAFF. (1975). Ministry of Agriculture, Fisheries and Food. Energy allowances and Feeding Systems for ruminants. Tech. Bulletin, 33. London. HM50.

McAllister, T. A.; K. J. Cheng; K. A. Beanchemin; D. R. C. Bailey; M. D. Pickard and R. P. Gilbert. (1993). Use of lignosulfonate to decrease the rumen degradability of canola meal protein. Can. J. Anim. Sci., 73 :211.

McKinnon, J. J., R. D. H. Cohen, S. D. M. Jones and D. A. Christensen (1993). Crude protein requirements of large frame cattle fed two levels of energy as weaned calves or as back grounded yearlings. Can. J. Anim. Sci., 73:315.

Mehrez, A. Z. (1992). Influence of roughage : concentrate ratio on nitrogen requirements of rumen microbes for maximal rate of fermentation. Proc. Int'1 conf. of Manipulation of Rumen Micro- Organisms to Improve Efficiency of Fermentation and Ruminal Production. Alex. Egypt. 20 – 23 Sep. 1992.

Mehrez, A. Z., E. M. Soliman, M. Y. El-Ayek; E. A. El-Ayouty and M. E. El-Kholany.(2001). Influence of roughage to concentrate ratio and type of roughage on digestibility , some rumen parameters and fiber fractions degradability of tested rations with ruminants. Egyptian J. Nut. and Feeds., 4: 193.

Mehrez, A. Z.; S. A. El- Ayouty; Z. M. K. Ibrahim and A. A. Younis (1993). Effect of feeding level on meat production from buffalo calves 2 – Growth performance and feed utilization. J. Agric. Sci. Mansoura Univ., 18 (1): 61.

Moonsie–Shageer, S. and D. N. Mowat (1993). Effect of level of supplemental chromium on performance, serum constituents and immune status of stressed feeder calves. J. of Anim. Sci., 71: 232.

Murphy, M.; P. Uden; D. L. Palmquist, and H. Wiktorsson. (1987). Rumen and total diet digestibilities in lactating cows fed diets containing full – fat rapeseed. J. Dairy Sci., 70 : 1572.

Mustafa, A. F., D. A. Christensen, and J. J. McKinnon (1996). The effects of feeding high fiber canola meal on total tract digestibility and milk production. Can. J. Anim. Sci., 76: 133.

Ørskov, E. R. and M. Ryle (1990). Energy nutrition in ruminants. Elsevier Applied Science, London,UK.

Palmquist, D. L. (1991). Influence of source and amount of dietary fat on digestibility in lactating cows. J. Dairy Sci., 74 :1354.

Patton, C. J. and R. Crouch (1977). Calorimetric determination of urea. Anal. Chem., 14:1147

Peters, T. (1968). Determination of blood total protein. Clim. Chem., 14:1147.

Robinson, P. H. ; G. R. Khorasani, and J. I. Kennelly. (1995). Evaluation of linseed meal for dairy cows. Interaction with grain source on forestomach and whole tract digestion. Can. J. Anim. Sci., 75 : 209.

Sanchez, J. M. and D. W. Claypool.(1983). Canola meal as a protein supplement in dairy rations. J. Dairy Sci., 66:80.

SAS (1992). Statistical Analysis System. User's Guide Inst.,Inc.Cary, NC.

Soliman, S. M.; B. E. Borhami; W. G. Fahmy and E. H. Ghoneim. (2001). Utilization of new protein sources by ruminants. Egypt. Nut. and Feeds., 4: 13.

Stanford, K.; T. A. McAllister, M. Pickard and K.J. Cheng (1995). Comparison of lignosulfanate – treated canola meal and soybean meal as rumen undegradable protein supplements for lambs. Can. J. Anim., Sci. 75: 371.

Stanford, K.; T. A. McAllister, B. M, less;Z.Xu and K.J. Cheng (1996). Comparison of sweet white lupin seed, canola meal and soybean meal as protein supplements for lambs. Can. J. Anim. Sci., 76:215.

Subuh, A. M. H., T. G. Rowan and T.I. J. Lawrence. (1994). Effect of heat or formaldhyde treatment and differences in basal diet on the rumen degradability of protein in soybean meal and in rapeseed meals of different glucosinolate content. Anim. Feed Sci. Technol., 49 : 297.

Taei, H. T. (1998). Effect of dietary level of protein and fiber on digestion, performance and carcass traits of sheep. Egypt. J. Nutr. and Feeds, 1 : 23.

Tesfa, A. T. (1992). Effects of rapeseed oil on rumen enzyme activity and in sacco degradation of grass silage. Anim. Feed Sci. Technol., 36 : 77.

Tesfa, A. T. (1993). Effects of rapeseed oil supplementation on digestion, microbial protein synthesis and duodenal microbial amino acid composition in ruminants. Anim. Feed Sci, Technol., 41 : 313.

Van Soest, P. J. (1965). Symposium on nutrition and forage and pastures. New chemical procedures for evaluation forages. J. Anim. Sci., 23 : 838.

Veen, W. A. G. (1986). The influence of slowly and rapidly degradable concentrate protein on a number of rumen parameters in dairy cattle.Neth. J. Agric. Sci., 34: 199.

Weser, U. and J. Koolman (1969). Reactivity of some transition metals on nuclear protein biosyntheis in rat liver. Experiential, 26: 246.

William, O. R. (1997). Physiology of Domestic Animals. 2nd Ed. Iowa State Univ. Press., U. S.

Zerbini, E.; C. E. Polan, and J. H. Herbein (1988). Effect of dietary soybean and fish meal protein digesta flow in Holstein cows during early and midlactation. J. Dairy Sci., 71: 1248.

تأثير التغذية بكسب الكانولا على أداء الحملان البرقى

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تم استخدام مائة من الحملان البرقى النامية في خمس تجارب تغذية لمدة (١٤٠ يوم) لتقييم استخدام كسب الكانولا بحيث يحل محل صفر، ١٠، ٢٠، ٣٠، ٤٠ % من بروتين العلف المركز. تم تكوين خمسة مركبات علفية متساوية البروتين والطاقة. واستخدمت في تغذية الحملان بنسبة ٢,٥ % من وزن الجسم مع إعطاء قش الأرز كمادة مالئة حتى الشبع.وقد أجريت خمس تجارب هضم لتقييم العلائق المستخدمة.

أوضحت النتائج أنه بزيادة كسب الكانولا في العلائق قد أدت إلى زيادة معنوية في معاملات هضم البروتين الخام ومستخلص الأثير والكربوهيدرات الذائبة، مع ارتفاع قيم المركبات الغذائية المهضومة للعلائق المستخدمه.وزيادة النيتروجين المحتجز بالجسم وزيادة مجموع الأحماض الدهنيه الطيارة لسائل الكرش. كما ارتفعت نسب البروتين الكلى في سيرم الدم وكذلك معدل النمو اليومي وتحسنت الكفاءة التحويلية(كجم غذاء / كجم نمو). بينما لم تكن هناك فروق معنوية في معاملات هضم المادة الجافة والمادة ألعضويه وقيم البروتين المهضوم والطاقة المهضومة والطاقة الممثلة للعلائق المختبرة ونسب الالبيومين والجلوبيولين في سيرم الدم، وكذلك المأكول الكلى من المادة الجافة. هذا بينما حدث انخفاض معنوى فىمعامل هضم الالياف الخام وفى قيم الاس الهيدروجينى وفى مستوى امونيا الكرش ويوريا سيرم الدم. ووفقا لهذه النتائج يمكن القول بأن استخدام كسب الكانولا حتى ٤٠ % من بروتين العلف المركز لم يحدث أضرار للحملان النامية، فضلا عن انه اقتصادى وبالتالي يمكن استخدام كسب الكانولا كأحد مصادر بروتين الأعلاف المركزة وخاصة مع نقص مصادر البروتين في مصر مع الاحاطه بأنه يجب إجراء المزيد من الدراسات الغذائية مع أنواع المجترات المختلفه وفى مراحل انتاجيه مختلفه.