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Original article

Effects of canola meal diets on growth performance, carcass characteristics and thyroid hormones in Atabay finishing lambs

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ABSTRACT

This study was conducted at north part of Iran (Golestan province), to investigate the effects of canola meal on growth performance, carcass quality and thyroid hormones in lambs. Twenty four male Atabay lambs were in a completely randomize design (CRD) with 4 treatments and 6 replications. Gaded levels of canola meal (0, 33, 66 and 100 percent) were used instead of cottonseed meal. Lambs were weighed, and feed consumption was recorded for feed efficiency ratio computation in every month and whole of the experimental period. Finally carcass analysis was carried out for every treatment. The canola meal used in this experiment contained 14.75 µmole/g DM aromatic glucosinolates. The results obtained showed that the effects of different levels of canola meal on daily gain during the whole experimental period was not significant ($p>0.01$), significant difference ($p<0.01$) was however recorded in the second month of the study. Feed consumption showed a significant difference between treatments ($p<0.01$), moreover, increase in canola meal inclusion rate in the diets did not affect the feed efficiency ($p>0.01$). Carcass characteristics, except for liver weight, were not statistically different ($p>0.01$). Effect of different levels of canola meal on thyroid hormones secretion was not statistically significant

(P>0.01). Therefore, it is recommended that canola meal can be used in the diets of Atabay finishing lamb without any problem.

1. Introduction

The canola meal is a byproduct that obtained from the processing of canola seeds for oil extraction. Canola was bred from industrial rapeseed in Canada during 1960s and the old varieties of this meal, have some anti nutrients factors, mainly glucosinolates that hydrolyzed by myrosinase iso-enzymes (Shahidi, 1990). Glucosinolates and their hydrolytic products are commonly referred to as goitrogens (Bell and Shires, 1982). Presence of glucosinolates in the diets leads to hypothyroidism in animals, reducing the level of thyroid hormones and alters the ratio between triiodothyronine (T3) and tetraiodothyronine (T4) in blood (Bell and Shires, 1982). The canola meal, genetically improved to reducing the amount of their glucosinolates. Canola contains less than 2% erucic acid and 30 µmole/gr glucosinolates. However, rapeseed contains 25-45% erucic acid and 50–100 µmole/gr glucosinolates (Bell, 1993). The process affects the protein quality of canola meal in during the oil extraction (Hikhing, 2001). Depending on the processing method, usually includes seed flaking and cooking (Hickling, 2001), ruminal escape or bypass protein of canola meal is slightly lower or similar to soybean meal (Hill, 1991). Zinn, (1993) reported that ruminal degradabilities for canola meal to be slightly lower than soybean meal. Petit and Veira (1994) reported increased weight gains in growing calves fed diets supplemented with canola meal. Hopkines et al. (1995) suggested that use of canola meal in the diets of finishing lambs had no negative effects on thyroid activity. However, some authors indicated that inclusion of canola meal in the ruminant diets interfere the thyroid action results of myrosinase activity in canola meal (Hill, 1991; Lardy and Kerley, 1994; Derycke et al., 1999). So, the objective of this study was to determine the effects of canola meal as a protein supplement on growth performance, carcass quality and thyroid activity of lambs.

2. Materials and methods

The experiment was conducted at the Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, North of Iran. The climate of the area is tropical humid with distinct seasonal variation. The average temperature ranged from 15-36°C. The canola and cottonseed meals were purchased from Behpak Ind. Co. Ltd. Behshahr, Iran, that for preparing canola and cottonseed meals the oil removed by hexane extraction process. The glucosinolates content of canola meal were determined by High Performance Liquid Chromatography (HPLC) method described by Kaushik and Agnihotri (1999). Chemical composition of canola and cottonseed meals included that crude protein, ether extract, dry matter, crude fiber, total ash, calcium and total phosphorous was determined (AOAC, 1990).

Four dietary treatments that the canola meal protein (39.11%) replaced 0, 33, 66, and 100% of the cottonseed meal protein (38.21%) were tested (Table 1). All diets met the National Research Council (1984) recommendations for lambs. Twenty four male lambs (Atabay breed) of about 3 month age with similar weights (31.43±0.58 kg) were selected for this experiment. Before onset the experiment, the animals were cared by Golestan Vet. Ltd. The animals were randomly distributed into one of the four dietary treatments. Feed and water were provided ad libitum and experimental period lasted 84 days. Every month feed intake and gain were recorded and then feed conversion ratio calculated. In the end of experiment carcass analysis was done for each treatment by killing the lambs and separated the various parts of carcass.

On the last day of finishing period, blood was collected by jugular venipuncture into evacuated tubes, placed on ice, and transported to the laboratory. Plasma was harvested by centrifugation at 5000 × g at 4°C for 15 min and stored (-20°C) until analyzed for thyroid hormones. The plasma thyroid hormones triiodothyronine and thyroxine (T3 and T4) were measured by standard radioimmunoassay using commercial kits (Landa laboratory, Gorgan, Iran). Data from the experiment were subjected to ANOVA using SAS software (SAS Institute, 1990). Statistical significance of differences among treatments was assay using the Duncan multiple test at (P<0.01).

Table 1
Chemical composition of diets.

Parameter	0% CM	33% CM	66% CM	100% CM
Barley grain	51	49	48	48
Canola meal	0	4.95	10	15
Cottonseed meal	15	10.05	5	0
Beet pulp	15	16.5	16.5	15.5
Wheat straw	18	19	20	21
Limestone	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
ME[1] (Mcal/kg)	2.62	2.62	2.62	2.62
CP[2] (%)	12.5	12.5	12.5	12.5

[1] Metabolizable Energy, [2] Crude Proteins.

3. Results and discussion

The chemical composition of canola meal is shown in Table 2. The canola meal contained low total fiber (9.14%). Also, the amount of ether extract and total phosphorous in canola meal was 2.28 and 0.91%, respectively. However, canola meal is a good source of crude protein and Calcium, similar to cottonseed meal. Total glucosinolates value in canola meal was 14.75 µmole/g DM. Means of growth performance of lambs fed different dietary treatments are presented in Table 3. The average of gain was not significant between treatments in 84 days of finishing period ($p>0.01$). However, there are significant differences in second month of recording for gain ($P<0.01$). Lambs fed the diets containing 33% canola meal have a lower feed intake than those fed other diets ($p<0.01$). Feed conversion ratio was not statistically significant between treatments ($P>0.01$). However, these parameter was affected by inclusion rate of canola meal in different months of recording ($P<0.01$).

Table 4 is show the means of carcass analysis of lambs in each treatment. These data demonstrated that there was not significant differences for carcass quality for all treatments ($P>0.01$). Only, there was a significant difference for liver weight ($P<0.01$). In this case 0% and 100% canola meal diets have the lower and higher of liver weight, respectively**.** Data of thyroid hormones for treatments are presented in Table 4. There is not significant differences for both two hormones ($P>0.01$). However, amount of T3 and T4 were higher and lower in 0% and 100% canola meal diets, respectively. Depending on the processing of canola seed for prepare canola meal, chemical composition is varied. The process usually includes seed cleaning, seed preconditioning and flaking, seed cooking, mechanical oil extraction through crushing, and solvent extraction of the press cake, desolventizing and toasting. Canola meals contain approximately 36% crude protein compared to cotton seed meal. Canola meal used in this experiment contain of 14.75 µmole/g aliphatic glucosinolates. Some authors classified canola meal based on glucosinolates content, includes canola meal with low glucosinolates (less than 5 µmole/g), medium (between 10 to 30 µmole/g) and high (more than 30 µmole/g). Based on this classification, the canola meal used in our experiment was a medium canola meal. The glucosinolate content is generally higher in rapeseed meal varieties grown under tropical environment than those occur in temperate regions (Tripathi et al., 2001). Guitrogenic characteristic of canola meal firstly related to action of myrosinase enzyme, which hydrolyzed glucosinolates and produced nitriles, thiocyanates, isothiocyanates 5-vinyl -2- oxazolidinethionine and 5-vinyl-1, 3- oxazolodine 2-thione.

Table 2
Chemical composition of canola meal.

Parameter	Canola Meal (%)
DM[1]	92.13
CP[2]	39.11
EE[3]	2.28
Ash	6.52
CF[4]	9.14
Calcium	0.72
Phosphorous	0.91
Glucosinolates	14.75 (µmol/g DM)

[1] Dry Matter, [2] Crude Proteins, [3] Ether Extract, [4] Crude Fibers.

Table 3
Growth performance of lambs fed diets with different inclusion rates of canola meal.

Parameter	0% CM	33% CM	66% CM	100% CM	SEM
			(kg)		
Initial weight	31.90	31.81	32.12	32.11	2.33N.S.
Final weight	43.10	43.27	43.84	45.02	3.48N.S.
Gain			(g/day)		
First month	141.43	165.00	191.43	155.00	7.63N.S.
Second month	119.29	124.71	152.00	132.88	5.86*
Third month	146.70	133.21	124.29	140.71	7.50N.S.
Total period	139.76	122.02	130.24	142.86	6.13N.S.
Feed intake			(g/day)		
First month	1135	1149	1213	1135	52.65*
Second month	1335	1263	1306	1292	57.63*
Third month	1557	1364	1400	1578	43.15*
Total period	1348	1243	1322	1349	49.65*
FCR[1]			(g/day)		
First month	8.05	6.94	6.35	7.32	1.05*
Second month	11.20	9.25	8.57	9.78	1.38*
Third month	10.66	10.25	11.29	11.27	1.65N.S.
Total period	9.87	10.02	10.28	9.54	1.22N.S.

[1] Feed Conversion Ratio.

Table 4
Carcass quality and blood thyroid hormones (µg/dl) of lambs fed with different inclusion rates of canola meal.

Parameter	0% CM	33% CM	66% CM	100% CM	SEM
			(kg)		
Heart	0.143	0.156	0.146	0.145	0.01N.S.
Digestive	9.69	9.91	9.37	9.87	0.50N.S.
Liver	0.693	0.826	0.736	0.883	0.04*
Kidney	0.116	0.106	0.103	0.110	0.02N.S.
Lungs	0.643	0.723	0.626	0.726	0.05N.S.
Hormones			(µg/dl)		
T_3[1]	1.75	1.70	1.66	1.61	0.09N.S.
T_4[2]	9.03	9.01	8.60	7.50	0.71N.S.

[1] triiodothyronine, [2] tetraiodothyronine

Claypol, (1985) reported no differences in calves' performance during pre weaning or post weaning fed diets with canola meal substituted by soybean and cottonseed meal. Mandiki et al., (1999) reported that it can be use 305 canola meal in the diets of finishing lambs without any problem or negative effects in lamb's performance. Mustafa et al., (2000), Vincent et al., (1990) and Do Prado and Martins, (2000) indicated that lambs and calves fed the diets with inclusion rate of canola meal have appropriate performance. Generally, it can be concluded that the better performance of lambs fed with canola meal may be related to parameters such as high proportion of bypass protein (RDP), animal ability to digestion of protein in canola meal, low levels of glucosinolates compared with rapeseed meal and presence of small amount of tannins in canola meals. Canola meal tannins bonded to proteins and increased bypass protein (RDP) in canola meal (Rymer and Short, 2003).

There are less data about effects of canola meal on carcass quality of lambs in literature review (Hill, 1991). Derycke et al., (1999) reported that there was not significant effect in carcass quality of lambs fed with 25% canola meal. Use of canola meal with high glucosinolates or rapeseed meals lead to liver enlargement in pigs (Bell, 1985).

The liver weight of lambs fed with high inclusion rate of canola meal in our experiment was greater compared with low conclusion rate diets and agree with Bell (1985) findings. However, in contrast with previous study, we use canola meal with low glucosinolates.

The presence of dietary glucosinolates is known to impair the thyroid function of domestic animals (Shahidi, 1990). Lardy and kerley, (1994) indicated that use of rapeseed meal don't has effects on triiodithyronine hormone, however, a linear decreased of tetraiodothyronine was observed with increasing of rapeseed meal in the diets of Holstein calves. These authors reported that increasing of glucosinolates by block of iodine leads to decreasing of thyroid hormones. The glucosinolates are not directly responsible for the deleterious effects on thyroid function, but toxicity of them is caused by their derivative products, such as thiocyanate anions and isothiocyanates (Bell, 1982). The processing time of canola meal and activity of intestinal micro flora affect these reactions (Shahidi, 1990). Data from mammals suggest that the low circulatory levels of T3 and T4 due to the intake of rapeseed meal stimulate excessive secretion of hypothalamic thyroid-stimulating hormone (TSH), which induces an increased thyroid follicle activity, resulting in a hypertrophy of the thyroid tissue (Mawson et al., 1994).

In conclusion, feeding lambs with different inclusion rate of canola meal compared with cottonseed meal has no negative effects on growth performance, carcass quality and thyroid hormones. Canola meal seems to be a good source of protein for growing lambs; however, its use in diets is limited by problems associated with palatability. Also, the guitrogenetic characteristics of canola meal mainly related to glucosinolates content and toxic byproducts that derivation from glucosinolates.

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