UTILIZATION OF LINSEED MEAL IN RATIONS FOR GROWING OSSIMI MALE LAMBS

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SUMMARY

Eighteen Ossimi male lambs, 5-6 months old, having an average live weight of 22.6 kg ±1.27, were assigned randomly to one of three growing lamb rations, 6 each, for a 16-weeks feeding period, to evaluate linseed meal (LM) compared to sunflower seed meal (SM). Ration 1 (control), consisted of a pelleted concentrate feed mixture (CFM), having SM as a sole main source of crude protein (CP), in addition to berseem (*Trifolium alexandrinum*) hay, while rations 2 and 3 were as ration 1, but LM substituted half or all SM, respectively, making the same CP contribution. Lambs fed LM, replacing all SM, ate 8.5 and 7% more CFM and hay, respectively, had a 17.2% higher daily weight gain, were 12.1 % heavier at the end of the experiment and converted feed dry matter and total digestible nutrients (TDN) into gain 7.1 and 2.5% , respectively more efficiently, compared to the control (P>0.05). Less improvements were observed with the (LM+SM)-ration. Feed intake related to body weight was similar for all groups. Lambs fed LM, replacing all SM, digested ration's CP and ether extract 8.7 and 12.5%, respectively, more than the control, while those fed (LM+SM) showed less improvements (3.7 and 7.0%, respectively), (P>0.05). Replacing half or all SM by LM improved fiber digestion by 10.2 and 11.0%, respectively, but decreased N-free extract digestibility by 4.7 and 4.8%, respectively compared to the control (P>0.05). Ration 3 was 5% higher in TDN value compared to the the control and (LM+SM)-rations (P>0.05), and had 15 and 19.2% more DCP (P>0.05) than the same two rations, respectively. Retained N in lambs fed ration 3 was higher (P<0.01) than in those fed (LM+SM) or the control rations. It is concluded that, LM is a better protein source for growing Ossimi male lambs compared to SM; increases feed intake and improves feed utilization, resulting in rapid higher gains and more net revenue when it substitutes all SM, but as a half substitution for SM, it results in less improvements.

Keywords: *linseed meal, Ossimi male lambs, feed intake, growth, digestibility, N utilization*

INTRODUCTION

Flax, also known as flaxseed or linseed (*Linum usitatissimum*), is an oilseed grown primarily for its oil rich seed. Moreover, linseed meal, a by – product of linseed oil industry, is characterized by its high content of both crude protein (404 g/kg) and ether extract (36 g/kg), with a low content of crude fiber (102 g/kg), fresh basis, (McDonald *et al.*, 1995). Flax in receiving diets has been reported to improve calf performance (Maddock *et al.*, 2006). However, there is a lack of information on the responses of growing Ossimi male lambs to linseed meal feeding. Therefore, the aim of this study was to evaluate the effects of linseed meal compared to sunflower seed meal as a main source of crude protein in rations for growing Ossimi male lambs, replacing half or all sunflower

seed meal of a concentrate feed mixture, on feed intake, growth performance , nutrients digestibility and N utilization.

MATERIALS AND METHODS

This experiment was carried out at El-Bostan area in Nubaria West, El-Behera governorate, Egypt. Eighteen Ossimi male lambs, 5-6 months old, having an average live weight of 22.6 kg ±1.27, were assigned randomly to one of three growing lamb rations, 6 each, to evaluate the effects of linseed meal (LM) compared to sunflower seed meal (SM) on feed intake, growth performance, nutrients digestibility and N utilization. Ration 1 (control), consisted of a pelleted concentrate feed mixture (CFM), having only SM as a sole main source of crude protein (CP), in addition to berseem (*Trifolium alexandrinum*) hay being offered *ad libitum* , while rations 2 and 3 were as ration 1, but LM substituted half or all SM, respectively, making the same crude protein contribution, i.e. providing zero, 14.3 and 28.6% of the CFM of these three rations, respectively (Table 1). Rations were offered individually for a 16-weeks feeding period. Concentrate feed mixtures were offered at 3% of lamb body weight (BW) per day. Feed residues, if any, were removed and weighed once daily before morning feeding. Fresh water and mineral blocks were available all time.

Table (1): Feed ingredients and nutrients composition of concentrate feed mixtures (CFM), linseed meal (LM) and sunflower seed meal (SM).

Item	CFM SM, Control	LM+SM	LM	Meals SM	LM
Ingredients, %					
Sunflower seed meal	40.0	20.0	--		
Lin seed meal	--	14.3	28.6		
Yellow corn	31.5	37.2	47.9		
Wheat bran	25.0	25.0	20.0		
Limestone	2.0	2.0	2.0		
Salt	1.35	1.35	1.35		
Vitamin and mineral premix	0.15	0.15	0.15		
Nutrients composition, (%, dry matter)					
Dry matter	90.0	90.0	90.1	92.4	92.6
Organic matter	90.4	91.7	92.4	84.8	93.5
Crude protein	15.1	16.1	17.9	25.0	35.4
Ether extract	3.67	3.94	4.63	8.80	12.64
Crude fiber	13.7	13.0	11.7	27.3	6.09
Nitrogen free extract	57.9	58.1	58.2	23.7	39.3
Ash	9.62	8.30	7.63	15.22	6.54

At the end of the feeding experiment, a 14-days digestion and nitrogen balance trial was carried out (7 days a preliminary period followed by 7 days for total collection of feces and urine). Five percentage daily samples of feces and urine were taken for analysis.

Feed ingredients of CFM's and chemical composition of SM, LM and CFM's are found in Table 1. Chemical composition of feeds and faeces, along with N content of urine samples were determined according to A.O.A.C. (2000) methods.

Data were subjected to analysis of variance as completely randomized design, using the general linear model procedure of SAS (1995), while Duncan multiple range test (Duncan, 1955) was applied to compare the means.

RESULTS AND DISCUSSION

Lambs fed LM, replacing all SM (treatment 3, T3) ate 8.5 and 7% more CFM and hay, respectively, had a 17.2% higher average daily weight gain (ADG) and were 12.1 % heavier at the end of the experiment, compared to the control (P>0.05), (Table 2). Moreover, these lambs (T3) tended (P>0.05) to convert feed dry matter (DM) and total digestible nutrients (TDN) into gain more efficiently (being 7.1 and 2.5%, respectively), compared to the control. However, they (T3) tended (P>0.05) to convert ration's digestible CP (DCP) into gain 9.6% less efficiently compared to the control, which may be a result of increased CP intake due to a high level of CP in their CFM, increased feed (hence CP) intake or both (Tables 1 and 2). Such high CP intake may be in excess of the animal's need. Lambs fed (LM+SM) - ration (treatment 2, T2) showed similar trends for the same parameters, as T3 lambs, but to less magnitudes (P>0.05). Feed intake related to BW was similar for all groups, indicating that the increase in feed intake due to LM feeding, replacing all SM, was coupled by a corresponding increase in BW. The increased feed intake with LM feeding can be attributed to improved digestion of most ration's nutrients (Table 3). McDonald *et al.* (1995) mentioned that in ruminants, there is a positive relationship between the digestibility of foods and their intake. Drouillard *et al.* (2002) also reported increased DM intake with the inclusion of flax at 10% of diet DM in finishing diets for cattle. Moreover, McDonald *et al.* (1995) reported that linseed meal given to fattening animals results in rapid gains compared with other vegetable protein supplements making the same protein contribution. Maddock *et al.* (2006) also observed that flax in receiving diets has improved calf performance.

Feeding LM, replacing all SM (ration 3), tended (P>0.05) to increase organic matter (OM) digestibility (4.6%) compared to the control, while there was no observed effect on the half substitution level (Table3). Lambs fed ration 3 also tended (P>0.05) to digest ration's CP and ether extract more (being 8.7 and 12.5%, respectively), compared to the control, while lambs fed (LM+SM) showed less improvements in CP and EE digestion (being 3.7 and 7.0%, respectively, P>0.05).

Replacing half or all SM by LM tended (P>0.05) to improve fiber digestion by 10.2 and 11.0% but slightly affect N-free extract digestion to be less by 4.7 and 4.8%, respectively compared to the control (P>0.05). Ration 3 was 5% (P>0.05) higher in TDN value compared to the control and (LM+SM)-rations and had 15 and 19.2% more DCP (P>0.05) than the same two rations, respectively, which could be a result of the improved digestion of most rations nutrients. In accordance with the present results, Wachira *et al* (2000) observed a positive effect on OM and fiber digestion when linseed (11% of DM) was fed to sheep. Also, Ueda *et al* (2003) found that supplementation with linseed oil caused modest increases in total – tract DM and OM digestibility, greater apparent N

digestibility and a tendency for increased NDF and ADF digestibility of dairy cows. Moreover, Martin *et al.* (2008) found that starch digestibility was similar for dairy cows fed a control diet or the same diet with crude linseed, extruded linseed or linseed oil at a fatty acid level of 5.7% of dietary DM.

Table (2): Growth performance of Ossimi male lambs fed linseed meal (LM), replacing half or all sunflower seed meal (SM).

Item	SM, Control	LM+SM	LM	SE
Dry matter intake				
Concentrate	940	950	1020	70
Hay	720	710	770	30
Total	1660	1660	1790	110
Total (%, of BW)	4.45	4.39	4.38	0.018
Rough: Concentrate ratio	1:1.31	1:1.33	1:1.32	0.002
Initial body weight, kg	22.0	22.1	23.3	2.19
Final body weight, kg	48.6	49.5	54.5	2.81
Average daily gain, g	238	245	279	13.1
Feed conversion				
Kg DM/kg gain	7.0	6.8	6.5	0.44
Kg TDN/kg gain	4.35	4.23	4.24	0.30
Kg DCP/kg gain	0.73	0.73	0.80	0.60

Means within rows are not significantly different (P>0.05).
SE: Standard error of the mean BW: Body weight DM: Dry matter
TDN: Total digestible Nutrients DCP: Digestible crude protein

Table (3): Digestibility and N utilization of Ossimi Male Lambs fed linseed meal (LM), replacing half or all sunflower seed meal (SM).

Item	SM, Control	LM+SM	LM	SE
Digestibility, %				
Organic Matter	66.8[a]	65.5[a]	69.9[a]	3.31
Crude protein	72.3[a]	75.0[a]	78.6[a]	3.41
Ether extract	76.8[a]	82.2[a]	86.4[a]	2.59
Crude fiber	49.0[a]	54.0[a]	54.4[a]	3.73
Nitrogen free extract	76.4[a]	72.8[a]	72.7[a]	2.53
Total digestible nutrients	62.3[a]	62.4[a]	65.4[a]	1.96
Digestible crude protein	10.4[a]	10.8[a]	12.4[a]	0.68
Nitrogen intake, g/d	46.59[a]	56.92[a]	58.33[a]	1.64
Fecal N, g/d	12.90[a]	14.23[a]	12.48[a]	1.36
Urinary N, g/d	26.75[b]	35.12[a]	36.56[a]	1.50*
Retained N, g/d	6.94[b]	7.57[b]	9.29[a]	0.39**

a, b: Means within rows, having similar superscripts are not significantly different (P>0.05), while those having different superscripts differ significantly (*: P<0.05) or (**: P<0.01). SE: Standard error of the mean.

Intake of dietary N was similar for lambs fed LM as a complete (treatment 3, T3) or a half (treatment 2, T2) substitution for SM, tending (p>0.05) to be higher than N intake of

control lambs, (Table 3). A similar but significant (P<0.05) trend was observed for urinary N. However, fecal N of T3-lambs tended (P>0.05) to be lower than those of T2-lambs and the control.

Fecal N related to N intake was the lowest in T3-lambs (21.4%) followed by T2-lambs (25%) and finally the control (27.7%). Absorbed N was 45.85, 42.69 and 33.69 g/d for T3, T2 and control, respectively. The higher absorbed N in lambs fed LM is mainly due to higher intake and digested N. Retained N in T3-lambs was higher (P<0.01) than those of T2-lambs and control (Table 3), but urinary N related to absorbed N was almost similar in T3 and control lambs (79.7 and 79.4%, respectively) being lower than in T2-lambs (82.3%). This indicate that the higher retained N in lambs fed LM, replacing all SM, than that in lambs fed (LM+SM) or the control is mainly due to increased N intake, improved CP digestion (Table 3) and also might be a result of increasing efficiency of microbial protein synthesis (Ueda *et al.*, 2003). Increased energy value (TDN) of the ration, (Table 3) may also be involved in such positive effect. In accordance with the present results, Martin *et al.* (2008) observed that crude linseed, extruded linseed or linseed oil at a 5.7% fatty acid level of dietary DM depressed ruminal methanogenesis of dairy cattle. Depressing ruminal methanogenesis means a decrease in the energy loss of the ration, hence increased its ME. McDonald *et al* (1995) reported that the ruminant loss about 7 percent of its food energy as methane. Moreover, increased efficiency of bacterial N synthesis and increased duodenal flow of nonammonia N due to increased bacterial N flow, in sheep and dairy cows, with linseed oil supplementation to diets have been reported (Ikwueglu and Sutton, 1982; Sutton *et al.*, 1983; Broudiscou *et al.*, 1994 and Ueda *et al.*, 2003). Also, in accordance with the present results, McDonald *et al.* (1995) reported that linseed meal has a very good reputation as a food for ruminant animals, which is not easy to justify on the basis of its proximate analysis. Moreover, linseed meal protein is of poorer quality than those of soyabean or cottonseed meals, having lower methionine and lysine contents (McDonald *et al.*, 1995). McDonald *et al* (1995) also reported that linseed meal is unique among the oilseed residues in that it contains from 30 to 100g/kg of mucilage and that part of the reputation may be the result of that the mucilage is readily dispersible in water, forming a viscous slime having the ability to absorb large amounts of water, resulting in an increase in the bulk of the meal, which may increase retention time in the rumen and give a better opportunity for microbial digestion. They also reported that the lubricating character of the mucilage also protects the gut wall against mechanical damage and, together with the bulkiness, regulates excretion and is claimed to prevent constipation without causing looseness.

Table (4): Economic efficiency of linseed meal (LM) inclusion in rations for Ossimi male lambs, replacing half or all sunflower seed meal (SM).

Item	SM, Control	LM+SM	LM
Total feed intake,kg/head	209	209	208
Feed cost/ head (112d) , LE	239.4	237	254
Total weight gain / head , kg	26.6	27.4	31.2
Selling price (head), L.E	1166.4	1188	1308
Net revenue / (head), L.E	399	420.6	494.8
Relative economic efficiency, %*	100	105.4	124.0

*: Assuming that economic efficiency of the control equals 100.

Feed cost of lambs fed LM, replacing all SM, was higher compared to the control or those fed (LM+SM)-ration, due to increased feed intake (Table 4). However, their better feed conversion associated with a superiority in ADG resulting in a 4.6 kg more BW gain/lamb, compared to the control, could compensate for the cost of the increased feed intake, resulting in a more net revenue/lamb (95.8 LE/lamb), i.e. a better economic efficiency (124.0%, compared to that of the control that assumed to be 100%). Moreover, due to the relatively less improvements obtained in growth performance with (LM+SM)-fed lambs, smaller increase in net revenue/lamb (21.6 LE/lamb) was obtained for this group, resulting in a smaller improvement in economic efficiency, being 105.4%, compared to the control.

CONCLUSION

It is concluded that, linseed meal is a better protein source for growing Ossimi male lambs compared to sunflower seed meal; increases feed intake and improves feed utilization, resulting in rapid higher gains and more net revenue when it substitutes all sunflower seed meal, but as a half substitution for sunflower seed meal, the same improvements occurs, but with less magnitudes.

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استخدام كسب الكتان فى علائق لذكور الحملان الأوسيمى النامية

سها سيد عبد المجيد؛ يحيى عبد الحليم معارك؛ ابراهيم محمد عوض الله؛ ممدوح ابراهيم محمد

قسم الانتاج الحيوانى؛ المركز القومى للبحوث؛ الدقى؛ القاهرة؛ مصر

تم توزيع ١٨ حمل أوسيمى عمرها من ٥-٦ شهور؛ ومتوسط وزنها ٢٢,٦ كجم عشوائيا على ثلاث علائق بهدف تقييم كسب الكتان مقارنة بكسب عباد الشمس من حيث التأثير على كمية المأكول؛ أداء النمو؛ معاملات الهضم والانتفاع بالأزوت. حيث استمرت التجربة ١٦ أسبوع؛ وكانت العلائق هى عليقة للمقارنة تكونت من مخلوط علف مركز يحتوى على كسب عباد الشمس كمصدر رئيسى للبروتين بمفرده بالاضافة لدريس البرسيم؛ بينما كانت العليقتين الثانية و الثالثة مثل عليقة المقارنة ولكن تم احلال كسب الكتان محل نصف أو كل كسب عباد الشمس فى مخلوط العلف المركز على التوالى مساهما بنفس كمية البروتين.

أوضحت النتائج أن الاستبدال التام لكسب عباد الشمس بكسب الكتان أدي لزيادة المأكول من مخلوط العلف المركز ومن الدريس وزيادة معدل النمو اليومي وتحسن كفاءة تحويل المادة الجافة للغذاء ، وكانت الحيوانات أثقل وزنا عند نهاية التجربة ، مقارنة بمجموعة المقارنة ، وقد لوحظ نفس التحسن بدرجة أقل عند إحلال كسب الكتان محل نصف كسب عباد الشمس ، ولم تتأثر نسبة المأكول كنسبة من وزن الجسم بالتغذية على كسب الكتان ، وقد تحسنت معاملات الهضم للبروتين الخام ، ومستخلص الأيثير ، والألياف الخام ، وزاد المحتجز من الأزوت، باستخدام كسب الكتان.

يستخلص من هذه النتائج أن كسب الكتان أفضل من كسب عباد الشمس كمصدر رئيسي للبروتين في علائق الحملان الأوسيمي الذكور حيث يؤدي لزيادة المأكول من العليقه وتحسن الانتفاع بالغذاء ، مؤديا لزيادة معدلات النمو وزيادة صافي الربح زيادة كبيرة في حالة الإحلال الكلي محل كسب عباد الشمس ، أما عند استخدامه كإحلال محل نصف كسب عباد الشمس فإن التحسن في أداء الحملان وكذلك الزيادة فى صافي الربح يكون أقل.