

EFFECT OF FENUGREEK SEEDS AND VEGETABLE OIL ADDITION ON DIGESTIBILITY AND NITROGEN AND ENERGY UTILIZATION OF SHEEP

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ABSTRACT: This work was carried out to study the effect of fenugreek seeds, vegetable oil or both on the feed intake, digestibility, nutritive values, nitrogen and energy utilization of mature rams.

Sixteen local sheep rams (51.6 kg) were randomly assigned to four groups, 1st group fed concentrate feed mixture (CFM) and rice straw, 2nd group fed CFM supplemented with 2% fenugreek seeds plus rice straw, 3rd group fed CFM supplemented with 2% vegetable oil plus rice straw and 4th group fed CFM supplemented with 1% fenugreek seed and 1% vegetable oil plus rice straw. Results showed that feed intake did not affected by fenugreek seeds or vegetable oil when added alone, but significantly ($P < 0.05$) increased, by both additions (group 4). Dry matter, crude protein and crude fiber digestibility did not significantly ($P < 0.05$) differ between all groups. Fenugreek seeds or vegetable oil significantly increased organic matter (OM) and nitrogen free extract (NFE) digestibilities on the other hand no significant difference was found in NFE digestibility between rams, which fed treatments 1 and 4. The total digestible nutrient (TDN%) and starch equivalent (SE %) significantly ($P < 0.05$) increased in rams fed diet supplemented with fenugreek seeds, vegetable oil or both in comparison with the control.

Also, fenugreek seed addition significantly increased the digestible crude protein (DCP%) group F. The digestibility of nitrogen significantly increased by fenugreek seeds and vegetable oil

addition (group 4) in comparison with the other groups. The retained nitrogen was significantly lower by vegetable oil addition alone, but retained nitrogen was improved in group (FO). Metabolisable energy significantly improved by addition of fenugreek seeds with vegetable oil group (FO).

The results of this study indicate that addition of fenugreek seeds or vegetable oil had beneficial effect on feed utilization. Also, addition of fenugreek seeds and oil together was better than addition of each alone.

Key words: Nutrition, ruminants, sheep, fenugreek seeds, vegetable oil, digestibility.

INTRODUCTION

The fenugreek seeds using as feed additives in ruminant rations seems to be recent trend globally. Fenugreek seeds was used to improve milk production and meat quality El-Shahat, 1986, Singh *et al.*, 1991; Tiwari, *et al.*, 1993. and Abdou, 2001. Moreover, fenugreek seeds arrangement estrus cycle, decrease anemia and mucus in respiration system for explosion mucus from the lung.

The effect of addition of vegetable oil to increase energy density in dairy rations and improve energy metabolism and milk production was investigated by Ostergard *et al.* (1981) Palmquist, (1984), Grummer *et al.* (1991) and Zervas, *et al.* (1998).

Some studies showed that addition of vegetable oil in the

ration has not effect on digestibility coefficient of DM, OM, CP and NFE while insignificantly decreased CF digestibility Eweedah, *et al.* (1997). However, Flachowsky *et al.* (1995), illustrated that vegetable oil addition tended to decrease OM and CF digestibility in sheep. While addition of vegetable oil in the ration until 3% has not affect the DM, OM, CP and CF digestibility (Chan *et al.*, 1997).

Adding vegetable oil with high quality protein (Fenugreek seeds) lead to increase milk yield (Ostergard, *et al.*, 1981 and Chan, *et al.*, 1997). This study aims to investigate the effect of fenugreek seeds or vegetable oil or both on the digestion coefficients, nutritive values and nitrogen and energy utilization by rams.

MATERIALS AND METHODS

This work was carried out in the Experimental Project Farms, Radioisotopes Applications Division, Nuclear Research Center, Atomic Energy Authority at Inshas.

Sixteen (local sheep) mature rams with an average body weight of 51.6 kg were assigned to four experimental groups (4 rams/each).

Group 1: (C) Fed concentrate feed mixture (CFM) plus rice straw.

Group 2: (F) Fed (CFM) with 2% Fenugreek seeds plus rice straw.

Group 3: (O) Fed (CFM) 2% vegetable oil plus rice straw.

Group 4: (FO) Fed (CFM) with 1% Fenugreek seed and 1% vegetable oil plus rice straw.

The concentrate feed mixture (CFM) and rice straw was offered as 2.5% from life body weight (LBW). The formulation and chemical composition of CFM with additives are shown in Table 1. Each ram was individually housed in metabolic cage for 5 weeks (4 weeks as adaptation period, and one week as collection period).

The feed intake, feces and urine were recorded daily in the collection period for urine collection used funnels into glass bottles containing 10 ml of 10N HCl then analyzed its proximate analysis according to A.O.A.C. (1980). Determination of calorific values for feed, feces and urine was done by using the programmable isothermal-jaket a calorimeter Julius Peters, Berlin, Germany, illustrated by Nasr (1982) and Mostafa (1992). Production of methane was calculated according to equation of Blaxter and Clapperton (1965) as follow:

$$\text{Methane CH}_4 \text{ (kcal/100kcal feed)} = 1.30 + 0.112D + L (2.37 - 0.05D)$$

Where D = the apparent digestibility of energy%.

L = the multiple of maintenance level of feeding.

Data of the experiment was statistically analyzed according to Snedecor and Cochran (1982) Complete random design model one way. Significant differences between treatment means were tested by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Chemical Composition

The chemical composition of consumed rations by rams are shown in Table 1. It could be seen that no significant differences were detected between the main constituents of the tested rations.

2. Feed Intake

The concentrate feed mixture (CFM) intake significantly ($P < 0.05$) increased by inclusion of fenugreek seeds and vegetable oil (FO) in comparison with the other groups (Table 2). No significant differences were found between the other groups. The dry matter intake of rice straw (RS) was insignificantly ($P < 0.05$) lower in rams of group (F) in comparison with the other groups. Abo EL-Nor (1999) reported that there is no significant decrease in dry matter intake by rations containing zero, 100 and 200g fenugreek seeds offered to lactate buffaloes. On the other hand Sharma (1986) found that fenugreek seeds contains saponin which may be enhanced appetite, generally total feed intake (CFM + RS) was significantly ($P < 0.05$) higher in rams fed fenugreek seeds plus vegetable oil (FO) group, which were 1196.95, 1018.7, 962.97 and 961.07 g/h/d

for FO, C, O and F groups, respectively (Table 2). Basha *et al.* (1987) reported that fenugreek seeds are assumed to have restorative and nutritive properties and stimulation the digestive process. Rotunno *et al.*, (1998) reported that it showed be supplemented ration with high quality protein in the case of fat addition.

3. Digestion Coefficients

Feed additives insignificantly increased digestibility of dry matter and crude protein ($P > 0.05$), while it was significantly increased organic matter digestibility.

However, the ether extract significantly ($p < 0.05$) decreased by fenugreek seeds addition (F). The addition of fenugreek seeds or vegetable oil tended to increased the digestibility coefficient of nitrogen free extract (NFE) groups (2,4). Similar results were reported by Ismail (2000). The insignificantly ($P < 0.05$) increase of CF digestibility by fenugreeks seeds with vegetable oil group (FO) addition may be due to stimulation of the rumen microflora activities through one or more of the following: (1) Decreasing number and activities of antagonistic organisms. (2) Saving some important micro factors to rumen micro flora as

microelements, vitamins, hormones enzymes or unknown factors, which are required to the efficient digestion, absorption and metabolism. (3) Decreasing hazard of some harmful heavy metals as lead by chelation with them. (4) Minimizing effectively hazard of mycotoxins by inhibition of fungi

growth and aflatoxin production (Allam, *et al.*, 1999) and for due to its essential fatty acids content for microorganisms in the rumen. Chan *et al.*, (1997) reported that addition of vegetable oil in the rations alone until 3% had no effect on DM, OM, CP and CF digestibility.

Table 1: Formulation and chemical composition of experimental rations

Items	Rations			
	C	F	O	FO
Ingredient (%):				
Yellow corn	35.00	35.00	35.00	35.00
Wheat bran	30.40	30.40	30.40	30.40
Cottonseed meal undec	22.00	20.00	20.00	20.00
Soya bean meal	10.00	10.00	10.00	10.00
Fenugreek seeds	-	2.00	-	1.00
Vegetable oil	-	-	2.00	1.00
Dicalcium phosphate	1.40	1.40	1.40	1.40
Common salt	1.00	1.00	1.00	1.00
Minerals mixture *	0.10	0.10	0.10	0.10
Vitamin mixture **	0.10	0.10	0.10	0.10
Chemical composition DM basis %				
DM	90.29	90.16	90.47	90.31
OM	91.98	92.77	91.94	92.41
CP	17.11	18.03	16.39	17.28
CF	13.00	10.70	13.01	11.69
EE	2.45	2.61	4.13	3.42
Ash	8.02	7.23	8.06	7.59
NFE	59.49	61.43	58.41	60.02
Gross energy MJ/kg ration	18.06	18.23	18.33	18.31

* Contains 5g CU, 30 g Fe, 40 g Mn, 45 g Z, 0.3 g I, 0.1 g Se and 881.6 g CaCo₃/kg mixture.

** Contain 20 million (I. U) Vit A, 2 Million (I.U.) Vit D3 and 2 g Vit E/kg mixture.

Table 2: Feed intake, digestion coefficients, nutritive values and feed units intake of rams fed experimental rations

Items	Rations			
	C	F	O	FO
Feed intake				
CFM(g/h/d)	899.6±00 ^b	899.80±0.1 ^b	841.7±60 ^b	1087.08±15.0 ^a
Rice straw (g/h/d)	119.10±27.1	61.17±11	121.27±6.0	109.88±25.0
Total DMI (g/h/d)	1018.70±27.0 ^b	961.07±11.0 ^b	962.97±59.0 ^b	1196.96±34.0 ^a
Digestion coefficient %				
DM	73.50±1.30	78.15±0.40	76.28±1.03	76.31±1.50
OM	75.62±1.20 ^b	80.89±0.50 ^a	78.98±0.80 ^a	78.49±1.30 ^a
CP	74.00±2.10	79.40±0.62	75.03±1.2	76.73±1.60
CF	65.15±4.80	59.43±5.40	64.03±2.20	68.13±0.40
EE	73.75±2.70 ^a	57.9±3.10 ^b	73.90±1.20 ^a	72.83±1.90 ^a
NFE	79.73±1.30 ^b	85.87±0.50 ^{ac}	84.67±0.20 ^a	81.68±1.60 ^{bc}
Nutritive values, %				
TDN	72.63±1.02 ^b	76.82±0.53 ^a	76.95±0.72 ^a	75.85±1.22 ^a
SE	67.81±0.95 ^b	72.69±0.50 ^a	72.08±0.68 ^a	71.44±1.14 ^a
DCP	12.67±0.37 ^b	14.31±0.12 ^a	12.30±0.19 ^b	13.25±0.28 ^b
Feed units intake (g/h/d)				
TDN	739.50±18.50 ^b	738.20±5.20 ^b	741.70±50.70	906.60±11.80 ^a
SE	690.50±17.20 ^b	698.50±4.90 ^b	694.80±47.60	854.00±11.20 ^a
DCP	128.95±4.30 ^{bc}	137.57±1.40 ^b	118.57±8.40 ^c	158.35±1.20 ^a

a, b, c means in the same row having different superscripts differ significantly (P < 0.05).

4. Nutritive Values

The total digestible nutrient (TDN%) and starch equivalent (SE%) significantly ($P < 0.05$) increased in rams fed diet supplemented with fenugreek seeds or and vegetable oil in comparison with the control group (Table 2). These results may be due to the high energy content in this ration. Fenugreek seeds addition tended to significantly ($P < 0.05$) increased the DCP% value. The Increase in TDN and SE by fenugreek seeds with vegetable oil group 4 these results may be due to the insignificantly increased of CP and CF digestibility of in comparison with the control. The feed units intake (TDN, SE and DCP) were significantly ($P < 0.05$) high in rams fed FO ration compared with the other groups. These results may be attributed to the high feed intake of FO group. Generally, all additives increased the intake of TDN, SE and DCP. El Shahat (1986) reported that fenugreek seeds addition improve nutritive values.

5. Nitrogen Utilization

The data presented in Table (3) illustrated that the daily nitrogen intake g/h/d and per kg $w^{0.75}$ were 27.89, 27.73, 25.25 and 33.1 g/h/d and 1.43, 1.45, 1.32 and 1.75 g/k

$w^{0.75}$, for C, F, O and FO rations, respectively. These results indicated that supplemented fenugreek seeds with vegetable oil tended to significantly increase the nitrogen intake than the other groups, while the feces and urinary nitrogen losses were not significantly affected. The results showed no significant differences between all rations for the total excreted nitrogen either as or g/h/d and g/kg $w^{0.75}$. The values of digestible nitrogen (g/h/d) were 21.1, 22.1, 19.0 and 25.5 g/h/d for C, F, O and FO rations, respectively. The inclusion of fenugreek seeds with vegetable oil showed significantly better digestible nitrogen than others.

Udayasekhara *et al.* (1987) and Nazar (1994) reported that addition of fenugreek seeds lead to decrease protein solubility in rumen and enhancing the efficiency of nitrogen utilization by rumen microorganisms. The values of retained nitrogen expressed as g/h/d and g/kg $w^{0.75}$ between C, F, O and FO rations showed significant differences. The increase of nitrogen retention (group FO) may be due to the increase of the digestible and nitrogen utilization by inclusion of fenugreek seeds (Abulafatih,

1987), also addition of vegetable oil with fenugreek seeds may be proved microorganisms by its requirements from energy and thereby increase digestible and retention of nitrogen.

6. Energy Utilization

The values of intake, digestible and metabolizable energy (Table 3) take the same trend as phase of nitrogen utilization.

The values of energy intake and energy losses in feces, urine and methane as well as efficiency of energy utilization improved by inclusion of fenugreek seeds and vegetable oil than the other groups. The results of gross energy (GE) intake were 18.40, 17.52, 17.65 and 21.92 MJ/h/d and 0.94, 0.92, 0.92 and 1.16 MJ/kg $W^{0.75}$ for groups C, F, O and FO, respectively (Table 3). The results showed significantly higher GE intake with FO than other groups. The average digestible energy values were 14.02, 14.16, 14.04 and 17.86 MJ/h/d, and 0.72, 0.74, 0.73 and 0.94 MJ/kg $W^{0.75}$ for C, F, O and FO rations respectively. The results of energy losses in the

urine were 0.66, 0.73, 0.4 and 0.58 for C, F, O and FO rations, respectively. While the gaseous energy losses as methane, were 1.42, 1.39, 1.37 and 1.56 MJ/h/d for C, F, O and FO rations, respectively (Table 3).

Grummer and Carrol (1991) showed that supplemented fat improve energy balance in cows. The metabolizable energy values were 11.94, 12.03, 12.27 and 15.72 MJ/h/d for C, F, O and FO rations, respectively. Results of Table (3) indicated that the inclusion of fenugreek seeds with vegetable oil tended to increase the DMI in group FO, which lead to enhanced gross energy intake and the values of digestible and metabolizable energy.

Conclusion

The results of this study indicate that addition of fenugreek seeds or vegetable oil had beneficial effect on feed utilization. Also, addition of fenugreek seeds and oil together was better than addition of each alone.

Table 3: Nitrogen and energy utilization of rams fed the experimental rations

Items	Rations			
	C	F	O	FO
Nitrogen metabolism:				
Daily nitrogen intake:				
g/h/d	27.89±0.70 ^b	27.73±0.30 ^b	25.25±1.50 ^b	33.10±0.90 ^a
g/kg w ^{0.75}	1.43±0.07 ^b	1.45±0.03 ^b	1.32±0.04 ^b	1.75±0.10 ^a
Daily excreted nitrogen:				
Feces Nitrogen (g/h/d)				
	6.83±0.70	5.66±0.20	6.25±0.40	7.59±0.40
g/kg w ^{0.75}	0.35±0.04	0.30±0.96	0.33±0.02	0.40±0.05
Urinary Nitrogen (g/h/d)				
	10.98±1.01	14.22±0.84	13.48±1.19	13.64±1.31
g/kg w ^{0.75}	0.56±0.06	0.74±0.03	0.70±0.04	0.71±0.06
Total excreted nitrogen (g/h/d):				
g/h/d	17.80±0.90	19.88±1.00	19.74±1.40	21.23±1.30
g/kg w ^{0.75}	0.91±0.06	1.04±0.04	1.03±0.05	1.11±0.06
Digestible nitrogen				
g/h/d	21.06±0.90 ^a	22.07±0.30 ^{ac}	19.00±1.30 ^{bc}	25.50±0.20 ^a
g/kg w ^{0.75}	1.07±0.06	1.16±0.03	0.99±0.04	1.34±0.05
Retained nitrogen:				
g/h/d	10.08±0.30 ^b	7.85±1.03 ^b	5.51±0.15 ^b	11.87±1.40 ^a
g/kg w ^{0.75}	0.51±0.02	0.41±0.06	0.29±0.105	0.63±0.09
Energy metabolism:				
Daily energy intake:				
MJ/h/d	18.40±0.49 ^b	17.52±0.19 ^b	17.65±1.08 ^b	21.92±0.62 ^a
MJ/kg w ^{0.75}	0.94±0.05 ^b	0.92±0.02 ^b	0.92±0.04 ^b	1.16±0.06 ^a
Fecal energy MJ/h/d				
	4.38±0.45	3.37±0.18	3.87±0.11	4.46±0.14
MJ/kg w ^{0.75}	0.22±0.023	0.18±0.01	0.20±0.006	0.23±0.007
Digestible energy:				
MJ/h/d	14.02±0.30 ^b	14.15±0.30 ^b	14.04±1.00 ^b	17.46±0.50 ^a
MJ/kg w ^{0.75}	0.72±0.02 ^b	0.74±0.01 ^b	0.73±0.03 ^b	0.94±0.06 ^a
Urinary energy MJ/h/d				
	0.66±0.18	0.73±0.19	0.40±0.12	0.58±0.23
MJ/kg w ^{0.75}	0.034±0.012	0.038±0.01	0.026±0.006	0.030±0.012
Methane energy MJ/h/d				
	1.42±0.02 ^a	1.39±0.04 ^b	1.37±0.07 ^b	1.56±0.03 ^a
MJ/kg w ^{0.75}	0.072±0.0007 ^b	0.073±0.002 ^b	0.070±0.004 ^b	0.082±0.0013 ^a
Metabolizable energy:				
MJ/h/d	11.94±0.40 ^b	12.03±0.30 ^b	12.27±0.90 ^b	15.32±0.60 ^a
MJ/kg w ^{0.75}	0.61±0.02 ^b	0.63±0.01 ^b	0.64±0.03 ^b	0.83±0.06 ^a

a, b means in the same raw having different superscript differ significantly (P<0.05).

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تأثير إضافة بذور الحلبة وزيت الطعام على معاملات الهضم وإستخدام النيتروجين والطاقة في الأغنام

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أجريت هذه الدراسة لمعرفة تأثير إضافة بذور الحلبة، زيت الطعام أو إضافتهما معا على الغذاء المأكول، معاملات الهضم، القيم الغذائية، تمثيل النيتروجين والطاقة في الكباش البالغة. استخدم ١٦ كبش (محلّيه) (متوسط الوزن عند البداية ٥١,٦ كجم ثم توزيعها عشوائيا على أربعة مجموعات (أربع كباش / مجموعة).

غذيت الأولى على مخلوط علف مركز + قش أرز، المجموعة الثانية على مخلوط علف مركز مضاف له ٢% بذور حلبة مع قش أرز، المجموعة الثالثة على مخلوط علف مركز مضاف له ٢% زيت طعام + قش أرز بينما غذيت المجموعة الرابعة على مخلوط علف مركز مضاف له ١% بذور حلبة + ١% زيت طعام و قش أرز.

وجد أن الغذاء المأكول لم يتأثر بإضافة بذور الحلبة أو زيت الطعام ولكن حدث تحسن معنوي في الغذاء المأكول بإضافتهما معا (المجموعة الرابعة). وجد أن معاملات هضم كلا من المادة الجافة، البروتين الخام، والألياف الخام، لم يتأثرا معنويا بالإضافات. بينما حدث زيادة معنوية في هضم المادة العضوية بإضافة الحلبة أو زيت الطعام كل على حده أو إضافتهما معا وجد أن إضافة الزيت والحلبة معا لم يؤثر على هضم الكربوهيدرات الذائبة بالمقارنة بالكنترول. بينما كانت معنوية عند إضافتهما كل على حده.

زادت قيم مجموع المركبات الكلية المهضومة (%TDN)، معادل النشا (SE) معنويا في الكباش المغذاة على عليقة مضافا لها بذور حلبة أو زيت الطعام أو إضافتهما معا بالمقارنة بالكنترول.

أيضا وجد أن إضافة الحلبة والزيت معا تزيد معنويا. النيتروجين المهضوم والمحتجز. وكذلك الطاقة المهضومة والقابلة للتمثيل. معظم نتائج هذه الدراسة تشير إلى أن إضافة بذور الحلبة أو الزيت تحسن من القيمة الغذائية كما أن إضافتهما معا أفضل من إضافة كل منهما بمفرده.