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Effect of Fenugreek (*Trigonella foenumgraecum*) Seeds Supplementaion on Feed Intake, Some Metabolic Hormones Profile, Milk Yield and Composition of Nubian Goats

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Abstract: A total of twelve mature nubian does were used in a complete randomize design to assess the effect of supplementing a basal diet with different levels of fenugreek seeds 0% (FS0%), 5% (FS5%), 10% (FS10%) AND 15% (FS15%) on feed intake, some metabolic hormones, milk yield and composition. The diet fed immediately postpartum for 2 consecutive months. Data pertains to feed intake (g/day) and milk yield (L/day) were recorded daily. Milk and blood samples for determination of chemical composition and serum concentration of Insulin, Triiodothyronine (T3) and Thyroxine (T4) were taken every 2 weeks, respectively. The results revealed that both daily feed intake and milk yield increased significantly ($p<0.05$) with the increased levels of fenugreek seed supplement with concomitant decrease in milk fat content while the other milk components (protein, lactose and SNF) showed an inconsistent pattern. On the other hand fenugreek seed supplementation at the 10 and 15% levels increased significantly ($p<0.05$) the concentration of insulin (11.32 and 13.66 mL U/L), T4 (86.00 and 92.27 mL U/L), respectively and a decreased in T3 concentration (1.33 and 1.12 mL U/L). The results highlighted that fenugreek seed supplementation boosted feed intake, milk yield, insulin and thyroxin.

Key words: Fenugreek, milk yield, composition, insulin, triiodothyronine, thyroxine

INTRODUCTION

Livestock play a significant role in providing food security as well as income resource for less poor people in Sudan. Therefore, it is necessary to adopt new and different strategies in animal production to increase productive performance.

In high yielding dairy animals, the onset of lactation increases the total energy requirements by approximately four folds, reflecting mostly the oxidative and milk precursor needs of the mammary gland (Bauman and Currie, 1980). Bell (1995) stated that after parturition dairy animals, suffer from an acute shortage of energy due to high consumption of energy to meet the milk production and the decrease of voluntary feed intake.

In animal feeding after banning the use of antibiotics as growth promoter, the use of alternative natural material become a very important issue in animal feed such as enzymes, organic acids and herbs (Awadein *et al*., 2010). The use of herbs in animal production may be related to their wide spectrum of nutritional and physiological effects depending on the herb. These effects may include antimicrobial and hormonal effects (Kuang *et al*., 1989).

Feed additives may be used in animal feed to improve the performance efficiency to increase dietary energy utilization and to maintain sound health and production (Abdel-Aal and Attia, 1993; El-Katcha, 1990).

The aim of this study was to investigate the effect of supplementing different levels of fenugreek seeds on feed intake, some metabolic hormones and milk yield and composition.

MATERIALS AND METHODS

Experimental site: This study was carried out during the period extending from April to July 2011 at the Animal Unit, Department of Animal Nutrition, Faculty of Animal Production, University of Khartoum (Shambat).

Experimental animals: Twelve mature Sudanese Nubian goats were purchased from a local livestock market (Abu Zaid) in Western Omdurman. The criteria adopted for selection of the goats in order to ensure homogenous groups were matching body weight, breed, age and late stage of gestation.

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Feed and feeding: Four isonitrogenous and isocaloric diets (Table 1) were formulated and offered daily to meet the nutrient requirements of goat according to NRC (1981). All animals fed a control diet before parturition which included (sorghum, groundnut cake, sesame cake, wheat bran, molasses, L. stone and NaCl). After parturition all animals received diet as follow: group FS0 was fed the control diet. Groups FS5, FS10 and FS15 fed the control diet supplemented with 5, 10 and 15% of crushed fenugreek seeds, respectively. The diet was offered *ad libitum* once a day with water available at all times. Green roughages were offered 3 times weekly. Feeding program continued for 2 consecutive months and feed intake was recorded daily.

The percentage of chemical composition of fenugreek seed is presented in Table 1 and 2 represents ingredients composition of experimental diet and then the chemical analysis of experimental calculated diet is presented in Table 3.

Milk sampling and analysis: After colostrums day were ended, the does were milked daily and milk yield was recorded, the kids were daily fed milk manually and milk samples were taken. Chemical analysis of milk samples (fat, protein, SNF and lactose) was determined by using milk analyzer lactoscan 90 according to the manufacture instruction (Aple industries service la Roche sur foron, France).

Table 1: Chemical composition of fenugreek seeds DM (%)

Component	DM	CP	CF	EE	Ash	NFE	ME (kcal kg^{-1})
Percentage	94.11	28.60	14.04	6.16	4.65	40.66	2368.17

ME: Calculated according to the equation of Lodhi *et al.* (1976); DM = Dry Matter; CP = Crude Protein; CF = Crude Fiber; EE = Ether Extract; NFE = Nitrogen Free Extract and ME = Metabolizable Energy

Table 2: Ingredient composition of the experimental diet (%)

	Level of fenugreek seeds			
Ingredients	FS0	FS5	FS10	FS15
Sorghum	55.0	53.0	50.0	51.0
GNC	5.0	5.0	5.0	3.0
SC	5.0	5.0	5.0	3.0
Wheat bran	14.0	11.0	9.0	7.0
Molasses	20.0	20.0	20.0	20.0
Fenugreek	0.0	5.0	10.0	15.0
L. stone	0.5	0.5	0.5	0.5
NaCl	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0

FS0 (0% Fenugreek Seed), FS5 (5% Fenugreek Seed), FS10 (10% Fenugreek Seed), FS15 (15% Fenugreek Seed), GNC = Groundnut Cake and SC = Sesame Cake

Table 3: Chemical analysis of experimental calculated diet

	Level of fenugreek seeds			
Ingredient	FS0	FS5	FS10	FS15
CP (%)	14.59	15.25	15.95	15.47
ME (MJ kg^{-1})	11.21	11.11	10.92	10.95
Ca (%)	0.488	0.48	0.48	0.42

FS0 (0% Fenugreek Seed), FS5 (5% Fenugreek Seed), FS10 (10% Fenugreek Seed), FS15 (15% Fenugreek Seed), CP = Crude Protein, ME = Metabolizable Energy and Ca = Calcium

Blood sampling and analysis: Blood samples were collected every 2 weeks at 10 a.m. from jugular vein using a 5 mL plastic disposal syringe. About 10 mL of blood were obtained from each animal into clean dry heparinized vacationers which were evaluated on the same day of collection (Schalm, 1965). Serum was separated by centrifugation at high speed of 4000 (rpm) at 30°C for 5 min and stored at -20°C.

Serum insulin was analyzed by insulin commercial kit and measured by Radioimmunoassay (RIA) using insulin iodination (iodine-125) and standard supplied by (Midgley *et al*., 1969). Serum Triiodothyronine (T3) and Thyroxine (T4) were measured by Radioimmunoassay (RIA) using T4-T3 Iodination (iodine-125) and standard supplied by Morgan and Lazarow (1962).

Statistical analysis: The data obtained from feed intake, milk yield and composition and serum for hormone were subjected to Statistical Analysis of Variance (ANOVA) for completely randomized design using computerized program known as statistix 8. A Least Significant Difference (LSD) was carried out to test significant difference between the treatment means.

RESULTS AND DISCUSSION

Effect of fenugreek seeds on feed intake and milk yield: According to the effect of fenugreek seeds on feed intake and milk yield which are shown in Table 4 the following important points can be observed.

The inclusion of fenugreek seed produced an almost immediate increase ($p<0.05$) in feed intake among treated groups. Under experimental conditions, goats supplemented with FS5, FS10 and FS15 consumed more dry matter 1083.3, 1231.8 and 1318.3 g day^{-1}, respectively than un-supplemented group 546.3 g/head/day.

The total milk yield during the experimental period responded positively ($p<0.05$) to fenugreek seed

Table 4: Effect of supplementation of different level of fenugreek seeds on feed intake (g/day/head) and milk yield (mL/day/animal)

Items	FS0	FS5	FS10	FS15	SEM
Feed intake	546.30^{b}	1083.3^{a}	1231.8^{a}	1318.3^{a}	88.59
Milk yield	381.78^{c}	1016.7^{b}	1138.4^{a}	1334.0^{a}	188.42

FS0 (0% Fenugreek Seed), FS5 (5% Fenugreek Seed), FS10 (10% Fenugreek Seed), FS15 (15% Fenugreek Seed), SEM: Standard Error of the Means. $^{a-c}$Values with in row with no common superscript differ significantly ($p<0.05$)

supplementation, furthermore, among the treated groups, goats fed diet having highest percent of Fenugreek Seeds (FS10 and FS15) had a greatest milk yield 1138.4 and 1334.0 mL day^{-1} than those fed the lowest percent of Fenugreek Seeds (FS5) 1016.7 mL day^{-1}.

Effect of fenugreek seeds on milk composition: The results of effect of fenugreek seeds on milk composition are presented in Table 5. The transition from 0-15% of fenugreek seed is associated with a reduction in fat content from 3.56-2.72% while the other milk components (protein, lactose and SNF) showed an inconsistent pattern.

Effect of fenugreek seeds on T3, T4 and insulin: This results clarify that increasing level of fenugreek seed caused a significant ($p<0.05$) reduction in T3 concentration (Table 6) but T3 concentration output among treated groups was not significantly ($p>0.05$) differ.

The secretion of T4 appeared to increase ($p<0.05$) in groups FS10 and FS15 than groups FS0 and FS5 by feeding Fenugreek seed diet (Table 6).

The elevated of insulin concentration correlated with the increasing level of fenugreek seeds supplementation, the higher concentration obtained by FS15 (13.66 mL U/L) followed by FS10 (11.32 mL U/L), FS5 (10.36 mL U/L) and FS0 (7.97 mL U/L).

The present study showed clearly that the groups of goats fed the fenugreek seeds supplementation diets secured higher feed intake. This result is in agreement with the results obtained by several researchers (Blumenthal, 1998; Broca *et al*., 2000; Petit *et al*., 1993; Tomar *et al*., 1996). The increase in feed intake might be partially due to the presence of saponins in fenugreek seeds which increase food consumption. Petit *et al.* (1993) concluded that saponins in fenugreek seeds increase food intake. In addition to that Abo El-Nor *et al.* (2007) stated that the increases in feed intake as result of feeding fenugreek may be attributed to its effect on hypothalamus to stimulate hunger centers in the brain and increase the desire for eating.

Table 5: Effect of supplementation of different level of fenugreek seeds on milk composition (%)

Items	FS0	FS5	FS10	FS15	SEM
Fat	3.56^{a}	3.38^{a}	2.94^{b}	2.72^{b}	0.14
Protein	3.74^{a}	3.50^{b}	3.52^{b}	3.59^{ab}	0.06
Lactose	5.21	4.88	5.35	5.07	0.30
SNF	9.63^{a}	9.01^{b}	9.16^{ab}	9.32^{ab}	0.17

FS0 (0% Fenugreek Seed), FS5 (5% Fenugreek Seed), FS10 (10% Fenugreek Seed), FS15 (15% Fenugreek Seed), SNF = Sold Non Fat; SME: Standard Error of the Means. $^{a-c}$Values with in row with no common superscript differ significantly ($p<0.05$)

Table 6: Effect of supplementation of different level of fenugreek seeds on T3, T4 and insulin (mL U/L)

Items	FS0	FS5	FS10	FS15	SEM
T3	2.09^{a}	1.37^{b}	1.33^{b}	1.12^{b}	0.10
T4	71.67^{b}	71.60^{b}	86.00^{a}	92.27^{a}	2.72
Insulin	7.97^{c}	10.36^{bc}	11.32^{ab}	13.66^{a}	0.90

FS0 (0% Fenugreek Seed), FS5 (5% Fenugreek Seed), FS10 (10% Fenugreek Seed), FS15 (15% Fenugreek Seed), SME: Standard Error of the Means. $^{a-c}$Values with in row with no common superscript differ significantly ($p<0.05$) T3 = Triiodothyronine; T4 = Thyroxine

Fenugreek is an herbal plant that is often used to increase milk supply. This study illustrated that feeding varying levels of fenugreek seeds led to progressive increase in milk production. The increase in milk production may be due to the presence of phytoestrogens which are plant chemicals similar to the female sex hormone estrogen which is a key compound to increase milk flow. Similar results were obtained by many researchers (Tiran, 2003) who found that fenugreek seeds contain a chemical compound (diosgenin) that has a similar role to the female sex hormone estrogen which has been experimentally proved to increase milk flow, this hormone promote development of the ductal system of milk glands. Furthermore, the ability of fenugreek seeds to increase milk might be due to the fact that this herb contains rich source of essential fatty acids. Mowrey (1998) reported that herb with high essential fatty acids increased milk production.

Milk fat content was significantly lower in group FS15 and FS10 compared with groups FS0 and FS5, there is an inverse relationship between yield and fat percentage. The lower fat content of both FS10 and FS15 can be justified by the higher milk yield secured by both group, compared to the FS0 and FS5, this result agrees with El-Alamy *et al.* (2001) who found that feeding fenugreek seeds to buffaloes increase milk yield but without any effect on milk composition except for a tendency of lower fat content. Milk lactose was not affected by supplementing different level of fenugreek seed. This result is similar to the results obtained by Kholif and Abd-El-Gawad (2001) who found that there was insignificant different on lactose content between all treated and control group.

The progressive increase of feeding of fenugreek seeds to the experimental animals resulted in an increase in insulin hormone secretion; this may be due to the presence of the amino acid 4, hydroxyisoleucine in fenugreek seeds. This amino acid appeared to act on pancreatic beta cells to enhance insulin production. This result agree with Baquer *et al.* (2009), Broca *et al.* (2000) and Schryver (2002) who reported that fenugreek seeds contain amino acid called 4 hydroxy iso leuciine which appears to increase the body's production of insulin. Ajabnoor and Tilmisany (1988), Devi *et al.* (2003) and Yadav *et al.* (2004) found that the extract of the whole

seed of fenugreek seeds, stimulate pancreatic insulin secretion. Moreover, the effect of fenugreek on feed intake related to its well documented ability to increase insulin sensitivity because fenugreek interferes with intestinal glucose absorption as a result of local effects at the gastro-intestinal level mainly due to dietary fibers contained in fenugreek seeds (Gad *et al*., 2006). Insulin sensitivity and glucose metabolism are involved in the complex endocrine regulation of feeding behavior (Hannan *et al*., 2007).

T3 and T4 hormones are absolutely required for normal physiology in animals. Increasing levels of supplementation of fenugreek seeds on diets resulted in decrease of serum T3 while increasing T4 level, this may be due to meet the highly metabolic demand of milk synthesis, milk is very metabolically expressive commodity it extract, 80% of the total circulation nutrient to the milk glands to synthesis milk, this result agrees with result obtained by Issi *et al.* (2011). The increase of T4 level might be due to concentrate ration used in experiment. Shetaewi and Ross (1991) reported that concentrate ration induced an increase of plasma T4 levels in lactating ewes or may be attributed to estrogenic compound that presence in fenugreek seeds which indirectly increased thyroid hormone T4 (Sauvaire *et al*., 1991). The increase of T4 and a decrease in T3 level may be due to the fact that the fenugreek seed extract impaired peripheral conversion of thyroid hormones resulted in a significant decrease in serum T3 with a concomitant increase in T4 levels (Tahiliani and Kar, 2000). Panda *et al.* (1999) reported that administration of fenugreek seed extract to both mice and rats revealed its effect on thyroid hormone that fenugreek inhibits the synthesis of triiodothyronine concentration estimated by decrease in serum triiodothyronine concentration and T3/T4 ratio and consequently increased thyroxine levels. Similar effects were observed with *Aegle marmelos* extract which was observed to decrease T3 with an increase in T4 serum concentration in male mice (Kar *et al*., 2002).

CONCLUSION

From the results obtained, it could be concluded that supplementing lactating goat's diets with medicinal plant is highly recommended as a new step in the field of animal production in the Sudan for improving productive performance of lactating goat regarding milk yield and composition.

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