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EFFECT OF *NIGELLA SATIVA* SEEDS ON GROWTH, NUTRIENTS DIGESTIBILITY AND SOME BLOOD METABOLITES IN MALE BEETAL GOATS

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ABSTRACT

Aim of study was to evaluate the effects of Nigella sativa seeds (NSS) supplementation on growth performance, digestibility and selected blood metabolites of male Beetal goats. Fifteen male Beetal goats were randomly divided into three groups A, B and C according to Completely Randomized Design. Group A male Beetal goats served as control and fed basal diet only whilst group B and C male Beetal goats were fed separately 5 and 10 g NSS respectively in form of total mixed ration having a crude protein 15.6% and ME 2.63 Mcal /kg, along with the basal diet for a period of sixty days. Data were statistically analyzed through one-way ANOVA followed by least significant difference test. Average daily gain (ADG), feed efficiency (FE) and dry matter intake (DMI) were affected by NSS. Male Beetal goats fed C and B (NSS based diet) had greater ADG and FE than the male Beetal goats fed A (control diet). Male Beetal goats fed C had greater DMI than the male Beetal goats fed A. Total tract DM, CF and CP digestibility were also affected by NSS. Male Beetal goats fed C and B had greater DM and CP digestibility than the male Beetal goats fed A. For CF, male Beetal goats fed C had greater digestibility than the male Beetal goats fed A. Blood plasma cholesterol and triglyceride were both affected by NSS. Male Beetal goats fed B and C had lesser plasma cholesterol and triglyceride than the Male Beetal goats fed A. In conclusion, 10 g NSS can be used in male Beetal goats' diet to improve their growth performance and digestibility.

Keywords: Digestibility, Male Beetal goats, Nigella sativa seeds, Growth

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INTRODUCTION

Goats commonly referred as "poor man's cow", make valuable contribution to family diet and economic welfare of poor farmers. In developing countries goats are predominantly raised under extensive grazing system. In this system, goats are reared on low-quality feed resources resulting in poor growth rates, low meat production and longer rearing period (Shahjalal *et al.* 1992). Intensive production system can increase meat and milk production of goats. However, concentrate-based diets under intensive production system can increase susceptibility to ruminal acidosis and affect production negatively (Dong *et al.* 2013; Plaizier *et al.* 2018). Traditionally, antibiotics have been used to improve growth performance of intensive feedlot ruminants (Dibner *et al.* 2005; Greathead, 2003). However, due to ban on the use of antibiotics as growth promoters in animals interest in alternative growth promoters have increased (Greathead, 2003).

Plants and their products can be used as growth promoters in animals (Makkar *et al.* 2007). Especially, plant seeds have increased growth performance in different animal species by improving nutrient utilization in digestive system (Valenzuela *et al.* 2017). Nigella sativa seed (NSS), commonly known as "black seeds" are one of those seeds (Al-Ghamdi, 2001), Nigella sativa seeds have anti-inflammatory, stomachic, digestive, spasmodic, anthelminthic and vermifuge effects (Abo-Donia *et al*. 2009). Cherif *et al*. (2018) reported increase in weight gain of fattening lambs when diets supplemented with 12 g/kg of NSS. Similarly, dietary NSS supplementation improved digestibility in sheep (Saleh, 2006).

Nigella sativa seeds contain more than 100 useful components, it is a important source of essential fatty acids, proteins, carbohydrates, vitamins A, B1, B2, C and niacin, minerals and carotene. Nutritional composition of black seed is crude protein 21%, carbohydrates 35% and fats 35-38%. Nigella sativa reduces the toxicity of cisplatin that induced fall in white blood cell count, hemoglobin levels and mean osmotic fragility of red blood cells (Nasir *et al.* 1991). Black seed is high in nutritional values like monosaccharides and non-starch polysaccharide component which is a useful source of dietary fiber and also is high in fatty acids, unsaturated and essential fatty acids which cannot be manufactured by the body alone and therefore animals acquire these from food. Fifteen amino acids are important part of the crude protein content of the black seed, including eight of the nine essential amino acids (Ferdous *et al.*1992)

Nigella sativa seeds are grown in developing countries of the world (Gilani *et al.* 2004) and more than 90% of the world goats are present in the these countries (Galal, 2006). Although, both sheep and goat are ruminants, their digestive physiology and feeding behavior are different (Hofmann, 1989). There is little information available on the effect of NSS on growth performance, feed intake and nutrient digestibility in fattening male Beetal goats. The present study was designed to evaluate the effects of different doses of NSS on growth performance, nutrient digestibility and plasma metabolites of in male Beetal goats.

MATERIALS AND METHODS

The study was conducted at Small Ruminants Training and Research Centre (SRT&RC), University of Veterinary and Animal Sciences, Pattoki. Total duration of the study was seventy-four days including fourteen days of adaptation and sixty days of treatment period. Animals were handled according to animal care and ethical review committee of the University.

Fifteen male Beetal goats (BW = 36 ± 1.9 kg; 10 - 12 months of age) were used in this study. During adaptation and treatment periods, the male Beetal goats were fed total mixed ration as a basal diet containing 15.66% crude protein (CP) and 2.65 Mcal metabolizable energy/kg (Table 1). The male Beetal goats were vaccinated against Pestis des Petitis Ruminitus (PPR), Enterotoxaemia (ET), Foot and Mouth Disease (FMD) and Contagious Caprine Pleuro Pnuemonia (CCPP) and de-wormed for ecto and endo-parasites. After adaptation period male Beetal goats were randomly assigned to one of three dietary treatment groups (n=5/group) according to Completely Randomized Design, (1) control diet containing no supplemental NSS (A), (2) a diet containing 5 g NSS (B), and (3) 10 g NSS (C). NSS is commonly called as black seed and has been used as therapeutics purpose for several years, it originated form southeastern Asia and was used in ancient Egypt, Greece, Middle east and Africa. Grounded NSS were mixed in TMR ration for feeding. Animals were offered feed in tie stalls on individual basis. *Ad libitum* availability of fresh and clean water was ensured during the entire experimental period. Refusals of feeds were measured and recorded on daily basis.

Feed intake and refusal data were recorded on daily basis. Before the start of the treatment period, initial body weight of all male Beetal goats was measured, and afterwards weekly weight of each animal was recorded till the end of the study. Feed efficiency was calculated by total weight gain divided by the dry matter intake (DMI); however, weight gain was calculated by final weight subtracted from the initial weight. During last 5 days of treatment period, digestibility trial was carried out. Refusals and faecal material were collected of 3 male Beetal goats from each treatment group. Faecal sample were collected by total collection method. Faecal samples were packed into polythene bags and stored under -20 until ^{o}C. Later, composite faecal samples were subjected to DM, CP, EE, CF and OM analyses according to the standard procedures of AOAC (2016).

Table.1: Ingredients and nutrients composition of total mixed ration (TMR) fed as basal diet to experimental groups.

Ingredients	Inclusion level (%)
Maize grain	25
Molasses	10
Oat silage	38
Rhode grass hay	2
Soybean meal	13
Canola meal	10
Mineral Mixture*	2
Calculated nutrient composition (%)	
Dry matter	67.17
Crude protein	15.6
ME**	2.63
NDF***	24.82
Ether extract	2.24
Crude fiber	13.5
Calcium	0.56
Phosphorus	0.41

* Mineral mixture composition (per kilogram): Dicalcium phosphate 708g; Sodium choloride 189g; Magnassium sulphate 86.0g; Ferous sulphate 8.9g; Manganese sulphate 4.9g; Zinc sulphate 3.2g; Copper sulphate 0.3g; Potassium iodide 0.087mg and Cobalt chloride 0.0089mg ; Sodium selenate 0.015mg. ;
**ME Mcal/kg= Metabolizable energy mega calories per kilogram; ***NDF= neutral detergent fiber

Blood samples of male Beetal goats were taken at the end of experiment from jugular vein in 20 ml sterilized disposable syringes and were transferred to EDTA coated tubes for bio-chemical analysis. Blood samples were centrifuged 3000 rpm for five minutes to separate plasma. All the plasma samples were labeled carefully and stored at -20 °C till further analysis (Ashmawy, 2015). Cholesterol and triglyceride levels were measured using cholesterol Liquicolor (CHOD-POP-Method) cat # 10017 and Triglyceride Liquicolor (GPO/PAP-Method) cat # 1285 kits, respectively.

Statistical Analysis: Data for DMI, weight gain, feed efficiency, nutrients digestibility and blood metabolites were analyzed through one-way ANOVA using university version of SAS (SAS Institute Inc, 2002-03). Significant differences were declared with $P \leq 0.05$. Comparison among the means were made through Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

In this study, total body weight gain and average daily gain were affected by the NSS inclusion in male Beetal goat diet (Table 2). Male Beetal goats fed C and B diets had 43% and 24% greater ADG and total body weight gain than the male Beetal goats fed diet A. However, there was no difference in ADG between male Beetal goats fed diets B and C. Similar to ADG, feed efficiency was affected by the NSS inclusion in male Beetal goat diet. Male Beetal goats fed C and B diet had 31% and 21% greater feed efficiency than the male Beetal goats fed diet A. However, there was no difference in feed efficiency in male Beetal goats fed diets B and C. Dry matter intake was affected ($P < 0.05$) by the inclusion of NSS in the diet. Male Beetal goats fed diet C had 12% greater intake than the male Beetal goats fed diet A diet. There was no difference in DMI between male Beetal goats fed A and B diets and between male Beetal goats fed B and C diets. Nigella sativa seeds contain a mixture of essential fatty acids especially linoleic acid (50.2%), oleic acid (19.9%), margaric acid (10.3%), cis-11, 14-eicosadienoic acid (7.7%) and stearic acid (2.5%) which are considered essential for body growth (Babayan *et al*. 1978; Sultan *et al*. 2009). Similar to our findings, several studies have reported increased growth rate of ruminants after dietary supplementation of NSS (Saleh, 2005; 2006, Cherif *et al.* 2018). El-Ghousein (2010) found that supplementation of NSS in diet of pregnant Awassi ewes resulted in 29% and 40% greater weaning weight and ADG of their lambs due to 12% increase in milk production of the ewes. Cherif *et al*. (2018) reported increase in growth of lambs fed both 30% and 70% concentrate diets with 12g/kg NSS. Similarly, Habeeb and El-Tarabany (2012) reported 52% increase in average daily gain of Zaraibi kids when fed with concentrate feed mixture + berseem hay with 2g/kg NSS.

Table.2: Dry matter intake, average daily gain, final weight gain and feed efficiency in male Beetal goats supplemented with different levels of *Nigella Sativa* seed.

Parameters	Groups			P Value[4]
	A[1]	B[2]	C[3]	
DMI[5] /day (g)	$1235^{b}\pm28.38$	$1317^{ab}\pm16.6$	$1387^{a}\pm40.15$	0.012
ADG[6] (g)	$109.7^{b}\pm12.27$	$136.7^{a}\pm8.898$	$156.7^{a}\pm24.86$	0.003
Total Weight Gain (Kg)	$6.58^{b}\pm0.329$	$8.2^{a}\pm0.238$	$9.4^{a}\pm0.667$	0.003
Feed Efficiency	$0.086^{b}\pm0.0091$	$0.104^{a}\pm0.0083$	$0.113^{a}\pm0.0175$	0.015

[1]A=control group (fed only TMR); [2]B= Supplemented with 5 gram nigella sativa seeds per animal per day along with TMR; [3]C=Supplemented with 10 gram nigella sativa seeds per animal per day along with TMR; [4]declared significant when $p<0.05$; [5]DMI= Dry matter intake; [6]ADG= Average daily gain: body weight gain increase compared to daily basis
Data were presented as least square means ± standard errors.

Different inclusion levels of NSS have been used in ruminant diet. Cherif *et al*. (2018) reported positive effects of NSS over lamb growth, using 12 g/kg (of DM) of NSS. The only growth study conducted with male goats used 2 g/kg (of DM) of NSS and reported increase in growth and feed intake. Currently, there is no information about the inclusion of NSS in diet of fattening male Beetal goats in Pakistan. Therefore, in current study 2 different doses of NSS (5 and 10 g/ male Beetal goat) were used. To the best of our knowledge, this is the first study to report the effect of different doses of NSS on growth, feed intake, nutrient digestibility and plasma metabolites of fattening male Beetal goats in Pakistan. For intensive feedlot fattening of male Beetal goats, 60% concentrate-based diet was used in current study and to make sure male Beetal goats regularly consume their allotted dose of NSS (5 or 10 g/animal), everyday a measured quantity of NSS was mixed with their TMR. In our study, male Beetal goats fed B and C diets consumed 4 g/kg and 7 g/kg of DM, respectively.

In our study, digestive and appetite stimulant properties of NSS may have led to increased DMI of male Beetal goats fed C diets (Gilani *et al*. 2004). Similar to our study Habeeb and El-Tarabany (2012) reported 10% increase in DMI of Zaraibi kids supplemented with 2 g NSS /kg of concentrate feed. However, contrary to our study, Cherif *et al.* (2018) did not observe increase in DMI of lambs fed 70% concentrate-based diet and supplemented with 12 g/kg NSS. These results may be attributed to specie differences.

Similar to growth performance, total tract DM, CF and CP digestibility were affected by the NSS inclusion in male Beetal goat's diet (Table 3). There was no effect of NSS inclusion on EE digestibility. Male Beetal goats fed C and B diets had 8% and 5% greater DM digestibility than the male Beetal goats fed diet A. Similarly, male Beetal goats fed C and B diets had 5% and 3% greater CP digestibility than the male Beetal goats fed diet A. For CF, male Beetal goats fed C diet had 5% greater CF digestibility than the male Beetal goats fed diet A. There was no difference in CF digestibility between male Beetal goats fed B and A diets and between male Beetal goats fed B and C diets. The stimulating effect of NSS on digestive utilization could be another

reason explaining the higher production performance of lambs fed on high concentrate diet (Rao *et al*. 2003).Similar to our study, Khattab *et al*. (2011) found that buffalo calf fed diet supplemented with NS oil had significantly higher values of DM ,OM, CP and NFE digestibility. Similarly, Saleh (2006) reported that supplementation of 5 g NSS in growing lambs showed improved digestibility of CP, EE and NFE than the control group. However, Cherif *et al.* (2018) did not report increase in digestibility, which may be attributed to the differences in digestive physiology of sheep and goat.

Table.3: Nutrient digestibility (%) in male Beetal goats supplemented with different levels of *Nigella Sativa* seed.

Items%	Groups			P Value[4]
	A[1]	B[2]	C[3]	
Dry Matter	65.5^{b}±0.85	68.9^{a}±0.47	70.6^{a}±0.29	0.0024
Crude Fiber	60.3^{b}±0.16	61.5^{ab}±0.32	63.2^{a}±0.16	0.05
Ether Extract	67.0±3.84	70.3±3.61	69.4±3.45	0.103
Crude Protein	71.3^{b}±0.21	73.6^{a}±0.20	75.1^{a}± 0.24	<.0001

[1]C=control group (fed only TMR); [2]B= Supplemented with 5 gram nigella sativa seeds per animal per day along with TMR; [3]C=Supplemented with 10 gram nigella sativa seeds per animal per day along with TMR; [4]declared significant when p<0.05
Data were presented as least square means ± standard errors

Among plasma metabolites, cholesterol and triglyceride were both affected by NSS inclusion in male Beetal goat diet (Table 4). Plasma glucose level was not affected by NSS inclusion in male Beetal goat diet. Male Beetal goats fed both B and C diets had lesser plasma cholesterol and triglyceride levels than the male Beetal goats fed diet A. There was no difference in plasma cholesterol and triglyceride level between male Beetal goats fed B and C diets. Generally, the present results illustrated that triglycerides and cholesterol concentrations were significantly decreased in B and C groups compared to control (A) treatment. The present results are in agreement with El-Saadany *et al.* (2008) who conducted research on lactating Zaraibi goats. The reduction in cholesterol quantity as a result of Nigella Sativa seeds supplementation may be due to the higher content of unsaturated fatty acids in Nigella Sativa seeds. Similar results were reported by Mostafa (1998) on kids and Randa (2007) on Zaraibi goats. In addition, El-Saadany *et al.* (2008) reported that supplementation of Nigella Sativa seeds in the ration led to significant decrease of plasma cholesterol concentration. These constituents decrease plasma cholesterol by increasing bile synthesis and increasing cholesterol excretion in feces. Similar to our study, other studies reported decreased concentration of cholesterol and triglycerides in blood upon NSS supplementation (Al-dain *et al.* 2015; Saleh, 2005; Saleh, 2006).

Table.4: Blood metabolites in male Beetal goats supplemented with different levels of *Nigella Sativa* seed.

Blood Metabolites (mg/dl)	Groups			P Value[4]
	A[1]	B[2]	C[3]	
Cholesterol	128.05^{a}±6.78	105.92^{b}±2.66	94.34^{b}±2.19	0.005
Triglycerides	81.54^{a}±1.71	75.82^{b}± 1.052	71.35^{b}±0.57	0.0003
Glucose	98.7±3.98	88.7±3.92	87.7±3.88	0.0715

[1]A=control group (fed only TMR); [2]B= Supplemented with 5-gram nigella sativa seeds per animal per day along with TMR; [3]C=Supplemented with 10-gram nigella sativa seeds per animal per day along with TMR; [4]declared significant when p<0.05
Data were presented as least square means ± standard errors

Conclusion: It is concluded that the dietary NSS supplementation can improve the growth performance and total tract digestibility of nutrients of male Beetal goats. growth performance, feed intake and digestibility increase were more prominent when NSS was fed at the rate of 10 g/head/day in male Beetal goats. Therefore, inclusion of 10 g/head/day of NSS can be recommended in diet of fattening male Beetal goats.

Conflict of Interest: Authors declare that there is no conflict of interest.

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