Indian Journal of Animal Sciences **92** (7): 887–891, July 2022/Article
https://doi.org/10.56093/ijans.v92i7.119705

Effect of cumin (*Cuminum cyminum*) seed supplementation on production performance, nutrient digestibility and haemato-biochemical profile of Mehsana goats

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Received: 1 January 2022; Accepted: 6 May 2022

ABSTRACT

A study was carried out to investigate the effect of supplementation of cumin (*Cuminum cyminum*) seed (CS) on the production performance, nutrient digestibility and hemato-biochemical profiles of lactating Mehsana goats. Twenty lactating Mehsana goats (7 days post-partum) were assigned randomly into two groups (10 animals in each), control (CON: fed basal diet without supplement) and treatment (CS: basal diet supplemented with 10 g/animal/d of CS) for the duration of 60 days. The final body weight was significantly higher (38.09 vs. 34.04 kg) in the animals of CS group than the CON group. Feeding of cumin seed to the lactating goats did not influence daily dry matter intake. However, cumin seed supplementation increased milk yield (985 vs. 859 g/d), 4% FCM (818 vs 623 g/d) and ECM (952 vs. 742 g/d) as compared to the CON group. The percentages of milk fat, SNF, total solids and lactose were also improved by the supplementation of cumin seed. Apparent digestibility of dry matter was comparable in CON and CS groups. However, the digestibilities of crude protein (58.19 vs. 66.97%), crude fibre (47.05 vs. 55.28%), ether extract (67.00 vs.75.82%) and nitrogen free extract (65.25 vs. 75.32%) were significantly improved in cumin supplemented group. There was no effect on haematological parameters between the CON and CS groups. The supplementation of cumin has significantly improved glucose concentration in CS group when compared to the CON group. The concentrations of other estimated blood metabolites were not affected by the cumin supplementation in lactating goats. Based on the results of the present study, it can be concluded that cumin supplementation in the diet of lactating Mehsana goats at the rate of 10 g/d improved milk yield, nutrient digestibility and feed efficiency without any adverse effect on haemato-biochemical parameters.

Keywords: Blood metabolites, Cumin, Goat, Milk yield, Nutrient utilization

In India, goats provide sustainable livelihoods to many small, marginal farmers and landless labourers constrained with limited available resources. In addition to milk, goats also provide meat, manure and leather. As per 20th Livestock Census, total number of goats in the India and Gujarat are 148.88 and 4.86 million, respectively (BAHS 2019). They contribute about 3% of the total milk production in India. In Gujarat, total estimated milk production was 53,173 lakh kg in the year 2019 and goats contributed about 2,273 lakh kg milk (4.27% of total milk production). Goats are generally fed with poor quality forages, crop residues, and agro-industrial by-products with very minimal concentrate diets, which negatively affects their production performance. Goat milk has special interest amongst consumers as it has greater contents of short- and medium-chain fatty acids and small-size fat globules as compared to cow milk (Miller and Lu 2019). Nutrient digestibility, milk yield and composition can be altered by modifying the feeding regimen and phytogenic feed additive supplementation. In particular, plant biologically active compounds are being explored owing to the prohibition on the non-therapeutic use of antibiotics as growth promoters together with the critical preference of consumers to high quality and safe animal products (Clemensen *et al.* 2020, Pawar *et al.* 2021a).

Cumin (*Cuminum cyminum*) is among the phytogenic feed additives that hold promise as a natural additive to improve the efficiency of milk production in animals. Cumin belongs to the Apiaceae family and is well-known since ancient times as a medicine and spice in food. India is the world's largest producer of cumin with 9.12 lakh tonnes production and Gujarat is the single largest producer of cumin in the country with 4.82 lakh tonnes production in 2019-2020 (Anonymous 2021). Cumin seed is the hub of numerous bioactive compounds such as cuminaldehyde, alkaloids, flavonoids and terpenoids, which have various pharmacological properties such as antimicrobial, galactagogue, antioxidant, appetite enhancer and digestive stimulant (Singh *et al.* 2021). Previous studies reported positive effects of cumin seed supplementation on milk

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production in ruminants (Miri *et al.* 2013, Ghafari *et al.* 2015, Morsy *et al.* 2018, Değirmencioğlu *et al.* 2020). However, no study has been conducted in India to assess the effect of feeding cumin seed in lactating goats. The study was conducted with the hypothesis that the bioactive compounds in cumin seeds will enhance feed intake, feed efficiency and nutrient utilization, resulting in improved milk production and composition. Hence, the present experiment was taken up to evaluate the effect of cumin seed supplementation on production performance, nutrient digestibility and haemato-biochemical profile of Mehsana goats.

MATERIALS AND METHODS

Animals and experimental design: The experiment was conducted at Livestock Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India. The experimental protocol of this study was approved with the Institutional Animal Ethics Committee (VETCOLL/IAEC/2019/15/PROTOCOL-02). Twenty Mehsana goats (7d of lactation; average 860 g milk/d; 34.32±1.07 kg body weight) were randomly assigned to two experimental groups (10 goats per treatment) for 60 days. The two experimental groups were control (CON) which were fed with basal diet (containing concentrate mixture, green maize fodder and groundnut straw) and treatment (CS) which were fed basal diet supplemented with 10 g/animal/day of cumin seed. In CS group, ground cumin seeds were mixed into a portion of the concentrate thoroughly and provided once daily throughout the experimental period. The basal diet was formulated to meet the nutrient requirements as per ICAR (2013). The chemical composition of feeds and fodders fed to the experimental animals is given Table 1.

Table 1. Chemical composition (% DM basis) of feeds and fodder fed to experimental animals

Composition	Concentrate mixture	Green maize	Groundnut straw	Cumin seed powder
Dry matter	91.83	44.4	90.01	88.86
Organic matter	92.37	92.02	91.10	93.00
Crude protein	22.2	8.88	11.08	12.81
Crude fibre	6.90	28.54	36.50	10.65
Ether extract	3.07	1.58	0.99	8.04
Ash	7.63	7.98	8.90	7.00
NFE	60.2	53.03	42.53	61.51

Production performance: The body weights were recorded initially at the start of experiment and thereafter at fortnightly interval by using electronic weighing balance (100 kg±10 g). Goats were milked twice a day and individual milk yield was recorded daily. The 4% fat corrected milk (FCM) was calculated as per Gains (1928) and Davidson *et al.* (2008). Milk samples were collected at fortnightly interval for analysis of milk composition [fat, solids-not fat (SNF), protein and lactose] using EKOMILK Ultra Pro Milk Analyzer (Everest Instruments Pvt. Ltd.).

Apparent nutrient digestibility: The feed offered and left-over were recorded daily in order to calculate feed intake. A digestion trial of 5 days was conducted at the end of experimental feeding. Daily feed offered, feed left over and faeces were collected individually. After measuring the total amount, representative samples of feed offered, residual feed and faeces were preserved for analysis. The samples of feeds and faeces were analyzed for dry matter, ash, crude protein, ether extract and crude fibre according to AOAC (2007).

Haemato-biochemical parameters: On 60th day of experimental feeding, blood samples from jugular vein were collected from each animal in the vials with and without EDTA. The whole blood samples were analyzed for haemoglobin, haematocrit, total erythrocytes and leucocytes using Exigo EOS Vet Haematology Analyser (Boule Medical AB, Sweden). The serum samples were analyzed for concentrations of glucose, total proteins, albumin, urea, creatinine, triglycerides, cholesterol, serum glutamic pyruvate transferase (SGPT) and serum glutamic-oxaloacetic transaminases (SGOT) using Randox Monaco Analyser (Randox Laboratories Ltd., UK).

Statistical analysis: All the experimental data obtained were analyzed by one-way ANOVA for a randomized complete block design using the SPSS. Difference between treatments were statistically compared using post-hoc Tukey procedure, at 0.05 level of significance.

RESULTS AND DISCUSSION

Production performance: Effect of cumin seed supplementation on production performance of Mehsana goats is given in Table 2. The final body weight was significantly (P<0.05) higher (38.09 vs. 34.04 kg) in the animals of CS group as compared to that of CON group. The improved body weights may be attributed to increased nutrient digestibility in cumin fed group (Table 3). Feeding of cumin seed to the lactating goats did not influence (P>0.05) daily dry matter intake, indicating no negative effect of the cumin seeds on diet acceptability. This validates the hypothesis that goats have high tolerance toward the bitter taste of plant secondary compounds (García-Monjaras *et al.* 2021). In agreement with the present results, Morsy *et al*. (2018) observed that feeding of cumin seeds @ 10 g/d had no effect on DM intake of Damascus goats. Similarly, Miri *et al*. (2013) reported that supplementation of cumin seed extract at 1.27 and 2.53% DM intake had no effect on DM intake of lactating goats. Cumin seed supplementation increased yields of milk (985.3 vs. 859.4 g/d), 4% FCM (818.31 vs. 623.27 g/d) and ECM (951.95 vs. 741.87 g/d) as compared to the CON group. Similarly, there was increased yield of milk fat, total solids, protein and lactose due to feeding of cumin than the CON group (Table 2). The percentages of milk fat, SNF, total solids and lactose were improved (P<0.05) by the supplementation of cumin seed. Improved milk production performance may be partially attributed to galactopoietic properties of cumin seed, which were mediated by stimulating endogenous

hormonal secretion (Bhatt *et al.* 2009).

Table 2. Effect of cumin seed supplementation on production performance of lactating Mehsana goats

Parameter	CON	CS	SEM	Significance
Body weight (BW)				
Initial (kg)	33.86	34.61	0.740	NS
Final (kg)	34.04[a]	38.09[b]	0.940	*
Dry matter intake (DMI)				
DMI (g/d)	1091.32	1139.65	23.75	NS
DMI (% of BW)	3.21	3.48	0.038	NS
DMI (g/$W^{0.75}$)	77.40	77.13	0.850	NS
Yield (g/d)				
Milk	859.4	985.3	43.45	NS
4% FCM	623.27[a]	818.31[b]	37.55	**
ECM	741.87[a]	951.95[b]	43.48	*
Fat	18.63[a]	28.28[b]	1.449	*
Solids not fat	55.69	69.72	5.259	NS
Total solids	82.01[a]	106.63[b]	4.859	*
Protein	30.92[a]	36.65[b]	1.613	*
Lactose	23.52[a]	31.57[b]	1.498	**
Milk composition (%)				
Fat	2.196[a]	2.916[b]	0.087	**
Solids not fat	7.35[a]	7.96[b]	0.071	**
Total solids	9.54[a]	10.90[b]	0.16	**
Protein	3.61	3.70	0.026	NS
Lactose	2.77[a]	3.26[b]	0.062	**
Feed efficiency				
Milk (g)/DMI (g)	0.87	0.79	0.008	NS
4% FCM (g)/DMI (g)	0.72[a]	0.57[b]	0.007	*
ECM (g)/DMI (g)	0.84[a]	0.68[b]	0.008	*

[ab]Means in a row with different superscripts differ significantly (*P<0.05; **P<0.01; NS, non-significant). CON, Basal diet without additive; CS, Basal diet + 10 g/animal/day of cumin seed; FCM, fat corrected milk; ECM, energy corrected milk.

Moreover, improved nutrient digestibility caused by cumin supplementation and therefore increased nutrient supplied to mammary glands might have led to an increased production of milk. In cumin fed group, greater milk lactose percentage may be correlated to higher blood glucose levels (Table 4). Lactose is synthesized in the udder from blood glucose absorbed by the basal membrane of mammary epithelial cells (Osorio *et al.* 2016). Increased milk production with feeding of cumin seed in the diets of goats may also be due to higher milk lactose (Costa *et al.* 2019). Consistent with the present results, significant increase in milk production due to feeding of cumin seed have previously been reported in lactating goats and dairy cows (Miri *et al.* 2013, Ghafari *et al.* 2015, Morsy *et al.* 2018, Değirmencioğlu *et al.* 2020). Feed efficiency in terms of 4% FCM/DMI and ECM/DMI were significantly (P<0.05) improved in cumin supplemented group than the CON. Improved conversion efficiency of DMI into FCM and ECM in the present experiment is contributed by improved FCM and ECM yield with similar DM intake in cumin fed group.

Table 3. Effect of cumin seed supplementation on nutrient intake and apparent digestibility in lactating Mehsana goats

Attribute	CON	CS	SEM	Significance
Nutrient intake (g/d)				
Dry matter (DM)	1383.31	1366.92	15.35	NS
Concentrate DM	266.29[a]	267.92[b]	0.086	*
Roughage DM	1118.02	1099.65	14.31	NS
Crude protein	173.36	176.20	2.16	NS
Ether extract	21.23	21.83	0.205	NS
Crude fibre	435.66	430.17	5.84	NS
Nitrogen free extract	642.09	640.94	9.95	NS
Water intake	3157.5	3316.67	144.3	NS
Apparent digestibility (%)				
Dry matter	55.93	59.93	1.452	NS
Crude protein	58.19[a]	66.97[b]	1.836	*
Crude fibre	47.05[a]	55.28[b]	1.973	*
Ether extract	67.00[a]	75.82[b]	2.135	*
Nitrogen free extract	65.25[a]	75.32[b]	2.200	*

[ab]Means in a row with different superscripts differ significantly (*P<0.05, NS, non-significant). CON, Basal diet without additive; CS, Basal diet + 10 g/animal/day of cumin seed.

Apparent nutrient digestibility: Intake of nutrients and water during the digestion trial were similar (P>0.05) between both the groups. Apparent digestibility of dry matter was comparable (P>0.05) in CON and CS groups. However, the digestibility of crude protein (58.19 vs. 66.97%), crude fiber (47.05 vs. 55.28%), ether extract (67.00 vs. 75.82%) and nitrogen free extract (65.25 vs. 75.32%) were significantly (P<0.05) improved in cumin supplemented group as compared to the control group.

Table 4. Effect of cumin seed supplementation on haemato-biochemical profile of lactating Mehsana goats

Parameter	CON	CS	SEM	Significance
Haematological parameters				
Haemoglobin (g/dL)	8.03	8.04	0.0650	NS
Hematocrit (%)	21.97	21.99	0.213	NS
Erythrocytes (10^6/µL)	12.68	12.72	0.121	NS
Leukocytes(10^3/µL)	9.23	9.29	0.322	NS
Blood biochemical parameters				
Glucose (mg/dL)	52.6[a]	58.7[b]	1.082	**
Total protein (g/dL)	7.45	7.55	0.102	NS
Albumin (g/dL)	2.90	2.86	0.0376	NS
Urea (mg/dL)	44.41	44.25	1.483	NS
Creatinine (mg/dL)	0.971	1.001	0.0217	NS
Triglycerides (mg/dL)	27.8	36.3	0.0632	NS
Cholesterol (mg/dL)	100.19	106.45	3.435	NS
SGPT (U/L)	15.89	19.9	1.518	NS
SGOT (U/L)	76.41	84.28	2.292	NS

[ab]Means in a row with different superscripts differ significantly (**P<0.01, NS, non-significant). CON, Basal diet without Additive; CS, Basal diet + 10 g/animal/day of cumin seed; SGPT, Serum glutamic pyruvate transferase; SGOT, Serum glutamic-oxaloacetic transaminases.

Cumin contains phytogenic compounds like essential oils, saponins, and tannins which might have led to reduction in the methane emission (Khan and Chaudhary 2010) and improvement in the protein digestibility due to complex formation with proteins and improvement in the nutrient digestibility. Recent reports have shown that appropriate levels of plant secondary metabolites optimize and enhance ruminal fermentation *in vivo* (Pawar *et al*. 2021b) and therefore improve nutrient digestibility in ruminants (Pawar *et al*. 2019). Similar to the present findings, improved nutrient digestibility was observed on inclusion of cumin in the diet of goats and lambs (Morsy *et al*. 2018, El-Naggar and Ibrahim 2018).

Haemato-biochemical parameters: The effect of cumin seed supplementation on haemato-biochemical profile of lactating Mehsana goats is given in Table 4. There was no effect (P>0.05) on the concentrations of haemoglobin, haematocrit, erythrocytes and leucocytes between the CON and CS groups. The supplementation of cumin significantly (P<0.05) increased glucose concentration (58.7 vs. 52.6 mg/dL) when compared to the CON group. Higher blood glucose levels in cumin fed group may be because of shift in rumen fermentation towards more propionate production. Propionate is the most important precursor for glucose production in ruminants and has shown similar trend with improved milk production due to cumin supplementation. Other reason for greater serum glucose may be the antioxidant characteristics of cumin seeds (Hosseini *et al*. 2020). In line with the present findings, Morsy *et al*. (2018) observed greater serum glucose concentrations with feeding of cumin seeds in lactating goats. However, the concentration of plasma glucose were not affected (P>0.05) in cows fed diets supplemented with cumin seeds as reported by Ghafari *et al*. (2015). The inconsistent results obtained may be due to supplemental level of cumin seeds and species. The concentrations of total proteins, albumin, urea, creatinine, triglycerides, cholesterol, SGPT and SGOT were not affected (P>0.05) by the cumin supplementation in lactating goats. In contrast, Morsy *et al*. (2018) reported decrease in the levels of serum cholesterol after the feeding of cumin in lactating goats.

Based on the results of the present study, it can be concluded that cumin (*Cuminum cyminum*) supplementation in the diet of lactating Mehsana goats at the rate of 10 g/d improved nutrient digestibility and feed efficiency which resulted in improved milk yield without any adverse effect on haemato-biochemical parameters.

REFERENCES

Anonymous. 2021. Major spice/state wise area and production of spices. Spices Board India, Ministry of Commerce and Industry, Government of India. http://www.indianspices.com/sites/default/files/majorspicestatewise2021.pdf (Accessed on 8th December, 2021).

AOAC. 2007. *Official Methods of Analysis.* 18th ed., Association of Official Analytical Chemists, Gaithersburg.

BAHS. 2019. Basic Animal Husbandry Statistics-2019. Ministry of Fisheries, Animal Husbandry and Dairying. Available at https://dahd.nic.in/sites/default/filess/ BAHS%20%28Basic%20Animal%20Husbandry%20Statistics-2019%29_0.pdf accessed on 7th December, 2021.

Bhatt N, Singh M and Ali A. 2009. Effect of feeding herbal preparations on milk yield and rumen parameters in lactating crossbred cows. *International Journal of Agriculture and Biology* **11**: 721–26.

Clemensen A K, Provenza F D, Hendrickson J R and Grusak M A. 2020. Ecological implications of plant secondary metabolites-phytochemical diversity can enhance agricultural sustainability. *Frontiers in Sustainable Food Systems* **4**: 547826.

Costa A, Lopez-Villalobos N, Sneddon N W, Shalloo L, Franzoi M, De Marchi M and Penasa M. 2019. Invited review: Milk lactose–Current status and future challenges in dairy cattle. *Journal of Dairy Science* **102**: 5883–98.

Davidson S, Hopkins B A, Odle J, Brownie C, Fellner V and Whitlow L W. 2008. Supplementing limited methionine diets with rumen-protected methionine, betaine, and choline in early lactation Holstein cows. *Journal of Dairy Science* **91**: 1552–59.

Değirmencioğlu T, Şimşek E, Unal H, Kuraloğlu H and Özbilgin S. 2020. Effect of cumin seeds (*Cuminum cyminum*) in feed diets of Anatolian water buffaloes on shelter into gass concentration, milk yield and composition. *Bulletin UASVM Animal Science and Biotechnologies* **77**: 41–50.

El-Naggar S and Ibrahim E M. 2018. Impact of incorporating garlic or cumin powder in lambs ration on nutrients digestibility, blood constituents and growth performance. *Egyptian Journal of Nutrition and Feeds* **21**: 355–64.

Gains W L. 1928. The energy basis of measuring milk yield in dairy cows. University of Ilinois, Agriculture Experiment Station. Bulletin No. 308.

García-Monjaras S, Santos-Díaz R E, Flores-Najera M J, Cuevas-Reyes V, Meza-Herrera C A, Mellado M, Chay-Canul A J and Rosales-Nieto C A. 2021. Diet selected by goats on xerophytic shrubland with different milk yield potential. *Journal of Arid Environments* **186**: 104429.

Ghafari M, Shahraki A F, Nasrollahi S M, Amini H R and Beauchemin K A. 2015. Cumin seed improves nutrient intake and milk production by dairy cows. *Animal Feed Science and Technology* **210**: 276–80.

Hosseini S, Ramezan Y and Arab S. 2020. A comparative study on physicochemical characteristics and antioxidant activity of sumac (*Rhus coriaria L.*), cumin (*Cuminum cyminum*), and caraway (*Carum carvil*) oils. *Journal of Food Measurement and Characterization* **14**: 3175–83.

ICAR. 2013. *Nutrient Requirements of Cattle and Buffalo*. Indian Council of Agricultural Research, New Delhi, India.

Khan M M H and Chaudhry A S. 2010. Chemical composition of selected forages and spices and the effect of these spices on *in vitro* rumen degradability of some forages. *Asian Australasian Journal of Animal Sciences* **23**: 889–900.

Miller B A and Lu C D. 2019. Current status of global dairy goat production: an overview. *Asian Australasian Journal of Animal Sciences* **32**: 1219–32.

Miri V H, Ebrahimi S H and Tyagi A K. 2013. The effect of cumin (*Cuminum cyminum*) seed extract on the inhibition of PUFA biohydrogenation in the rumen of lactating goats via changes in the activity of rumen bacteria and linoleate isomerase enzyme. *Small Ruminant Research* **125**: 56–63.

Morsy T A, Kholif A E, Matloup O H, Elella A A, Anele U Y

and Caton J S. 2018. Mustard and cumin seeds improve feed utilisation, milk production and milk fatty acids of Damascus goats. *Journal of Dairy Research* **85**: 142–51.

Osorio J S, Lohakare J and Bionaz M. 2016. Biosynthesis of milk fat, protein, and lactose: roles of transcriptional and posttranscriptional regulation. *Physiological Genomics* **48**: 231–56.

Pawar M M, Joshi P C, Gami Y M, Patil S S, Patel M P and Patel J G. 2021a. The effects of dietary ricinoleic acid from castor oil on the zootechnical traits and haemato-biochemical profile of lactating Kankrej cows. *Veterinarski Arhiv* **91**: 125–35.

Pawar M M, Kamra D N, Agarwal N, Chaudhary L C and Chaturvedi V B. 2021b. Use of essential oils as feed additive for modulation of rumen fermentation and methanogenesis in buffalo. *Animal Nutrition and Feed Technology* **21**: 49–60.

Pawar M M, Kamra D N, Chaudhary L C, Agarwal N and Chaturvedi V B. 2019. Nutrients utilization, methane emission, immune function, blood metabolites and performance of buffalo calves fed *Trachyspermum copticum* seed oil. *Indian Journal of Animal Sciences* **89**: 63–70.

Singh N, Yadav S S, Kumar S and Narashiman B. 2021. A review on traditional uses, phytochemistry, pharmacology, and clinical research of dietary spice *Cuminum cyminum* L. *Phytotherapy Research*. **35**(9): 5007–30.