



Growth performance of Malabari Kids fed Complete Diets Spent Cumin Seeds

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## Evaluation of Growth, Digestibility and Economic Efficiency of Malabari Kids Fed Complete Diets Containing Spent Cumin (*Cuminum cyminum*) Seeds

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### ABSTRACT

A three-month feeding trial was conducted to evaluate the growth performance, digestibility, and economic efficiency of Malabari kids fed complete diets incorporating spent cumin (*Cuminum cyminum*) seeds. Eighteen Malabari kids, aged 3 to 4 months, were selected from the University Goat and Sheep Farm, Mannuthy, and randomly divided into three groups. Each group was assigned one of three complete rations: T1 (Control) – containing 16% CP and 60% TDN, T2 – containing 10% spent cumin seeds, and T3 – containing 20% spent cumin seeds. All diets were isocaloric and isonitrogenous. The average daily gain (ADG) and total weight gain were significantly higher in the T3 group (46.23 g/day and 3.88 kg) compared to the control (33.13 g/day and 2.78 kg), while the T2 group showed similar growth to both T1 and T3. Total dry matter intake was comparable across groups (20.01, 21.65, and 24.75 kg for T1, T2, and T3, respectively). Feed conversion efficiency was also similar, with values of 7.23, 6.47, and 6.50 for T1, T2, and T3, respectively. A digestibility trial conducted at the end of the feeding period revealed significantly higher dry matter (DM) and acid detergent fiber (ADF) digestibility in T2 and T3 compared to the control ( $p < 0.05$ ). Crude protein (CP) and crude fiber (CF) digestibility were significantly lower in T1 ( $p < 0.01$ ). No significant differences were observed among groups for the digestibility of ether extract (EE), nitrogen-free extract (NFE), organic matter (OM), and neutral detergent fiber (NDF). Feed cost per kg body weight gain was Rs. 164.87, Rs. 136.09, and Rs. 133.12 for T1, T2, and T3, respectively, with no significant differences. It is concluded that the inclusion of 20% spent cumin seeds in the diet is economically viable and enhances growth performance without compromising feed efficiency.

**KEYWORDS:** Digestibility, Growth performance, Malabari kids, Spent cumin

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### INTRODUCTION

In India, goats play a vital role in the livelihoods of landless, small, and marginal farmers who rely on pasture-based grazing. According to the 20th Livestock Census (2019), the goat population stands at 148.88 million, contributing 27.8% to the total livestock population. Despite this growth, agricultural production is increasing by only 1.5% to 2% annually, resulting in significant feed deficits, with rising feed costs further straining the livestock sector. To tackle these feed shortages, alternative feed resources, including herbal and agro-industrial by-products, are becoming essential.

Additionally, Kerala, known for its rich Ayurvedic heritage, specializes in producing herbal by-products derived from medicinal plants after extracting active compounds which provide excellent nutritional value

at an affordable cost. The integration of these by-products into a total mixed ration (TMR) or complete diets, a system where various feed ingredients are blended into a single, nutritionally complete diet, has gained popularity for improving feed utilization and reducing costs. Complete diets also facilitate the use of non-conventional feeds and addresses feed scarcity while reducing labor (Schingoethe, 2017). By preventing feed selection, complete diets ensure balanced nutrition and improves overall efficiency (Mendoza et al., 2016).

India stands as the largest producer and consumer of cumin seeds globally with Gujarat and Rajasthan being the largest producers in the country. India is estimated to produce about 70% of the world's cumin, with nearly 800,000 hectares under cultivation, yielding approximately 500,000 tonnes

annually (Rahman et al., 2020). After cumin oil extraction from Cumin seeds, a medicinal herb and commercial spice known for its bioactive compounds such as cuminaldehyde and terpenoids (El-Sawi and Mohamed, 2002). It also retains bioactive compounds from cumin seeds that enhance palatability (Arun et al., 2014). However, their potential as livestock feed remains largely unexplored. This study aims to evaluate the effects of complete diets containing spent cumin seeds on the growth performance and cost economics of Malabari kids, addressing both nutritional value and economic viability.

## MATERIALS AND METHODS

### Experimental Design and Feeding trial

Eighteen healthy Malabari kids, aged three to four months, were selected from the University Goat and Sheep Farm, College of Veterinary and Animal Sciences, Mannuthy, for this three-month study. The kids were weaned and housed individually in a well-ventilated, clean, and dry shed with appropriate facilities for feeding and watering. They were divided into three groups, each consisting of six animals, and were as uniform as possible with respect to age, sex, and body weight. The animals were randomly assigned to one of three dietary treatments: T1 (control, complete feed), T2 (complete feed with 10% spent cumin seeds), and T3 (complete feed with 20% spent cumin seeds), following a randomized block design. They were fed diets containing 16% crude

protein and 60% total digestible nutrients (TDN), based on ICAR standards (2013), with feed allowances adjusted fortnightly according to body weight. The feed intake and body weight of each kid were recorded fortnightly.

### Digestion trial

A digestion trial was conducted during the last five days of the feeding period. The feed and dung samples were analyzed for proximate principles following the methods outlined by the Association of Official Analytical Chemists (AOAC, 2016). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) content were measured using the procedures of Van Soest et al. (1991). Additionally, calcium and phosphorus content in both feed and feces were determined using standard AOAC methods.

### Statistical analysis

Statistical analysis of the experimental data was conducted using one-way ANOVA with SPSS 24.0, and means were compared through Duncan's multiple range test, as described by Snedecor and Cochran (1994)

## RESULTS AND DISCUSSION

### Chemical composition

Spent cumin seeds is a good source of CP and Ether Extract (Table 1). All the three diets were iso-nitrogenous.

Table 1. Chemical composition of spent cumin seeds and complete feeds (on DM basis)

Nutrients(%)	Dietary Treatments			
	Spent Cumin Seeds	T1	T2	T3
Dry matter	95.6±0.43	93.92±0.16	92.67±0.44	93.34±0.21
Crude protein	17.56±0.33	16.11±0.26	16.07±0.19	16.01±0.33
Crude fibre	37.45±0.57	15.89±0.04	16.88±0.02	17.89±0.66
Ether extract	9.02 ±1.21	2.53±0.25	2.29±0.05	2.21±0.81
Total ash	4.82±0.09	10.04±0.04	11.26±0.18	10.98±0.31
Nitrogen Free Extract	31.15±0.42	55.43±0.19	53.5±0.23	52.91±0.38
Neutral detergent fibre	52.07±1.88	42.23±0.91	45.61±0.76	40.14±0.33
Acid detergent fibre	24.38±0.24	23.22±0.44	23.14±0.16	23.17±0.36
Acid insoluble ash	1.02±0.99	5.21±0.02	4.89±0.04	4.67±1.01
Calcium (g per cent)	0.59	1.08±0.003	1.04±0.07	1.07±0.23
Phosphorus (g per cent)	1.47	0.51±0.01	0.57±0.037	0.59±0.06

## Growth performance

The total weight gains for kids fed T1, T2, and T3 were 2.78 kg, 3.41 kg, and 3.88 kg, respectively, with corresponding average daily gains (ADG) of 33.13 g, 40.67 g, and 46.23 g (Table 2). However, T3 showed significantly higher ADG and weight gain compared to T1 ( $p < 0.05$ ). This improvement in T3 may be attributed to phytochemicals like flavonoids, alkaloids, phenols etc. stabilizing the digestive system by reducing undesirable microbial metabolites like ammonia and biogenic amines, which relieved intestinal difficulties, stabilized the digestive system, and eventually improved weight gain as suggested by Franz et al. (2010) and Singh et al. (2019). Supporting the present findings, Smeti et al. (2015) observed increased ADG in kids of lactating goats fed diets containing rosemary essential oils compared to a control diet. Jami et al. (2015) and El-Naggar and Ibrahim (2018) also reported higher ADG in lambs fed cumin residue and cumin or garlic powder, respectively, compared to control diets. However, Mansoori et al. (2006) found no significant

difference in ADG between broilers supplemented with varying levels of cumin seed meal.

## Dry Matter Intake (DMI) and Feed conversion ratio (FCR)

The fortnightly average daily DMI of kids fed dietary treatments T1, T2, and T3 ranged from 160–380 g during the six fortnights of the study. Mir and Kumar (2012) found no significant effect of fenugreek seed inclusion on goat feed intake. El-Essawy et al. (2019) also observed no significant differences in DMI in crossbred cattle and lambs, respectively, with or without essential oil supplementation. However, Al-Kassi (2010) reported increased feed intake with 1.5% cumin seed supplementation in broilers, and Aderinboye et al. (2021) found reduced feed intake in goats fed turmeric compared to controls. Feed conversion efficiency (kg feed per kg body weight gain) for kids fed T1, T2, and T3 was 7.23, 6.47, and 6.50, respectively (Table 2), with no significant differences between groups.

Table 2. Body weight, total weight gain, average daily gain and feed conversion efficiency of experimental kids

Parameters	T1	T2	T3	p value
Initial bodyweight(kg)	5.41±0.35	5.35±0.39	5.66±0.61	0.881
Final bodyweight(kg)	8.20±0.39	8.76±0.49	9.55±0.91	0.342
Total weight gain (kg)	2.78 <sup>b</sup> ±0.08	3.41 <sup>ab</sup> ±0.25	3.88 <sup>a</sup> ±0.39	0.04*
Average daily gain (g)	33.13 <sup>b</sup> ±1.03	40.67 <sup>ab</sup> ±3.01	46.23 <sup>a</sup> ±4.75	0.04*
Total dry matter consumed (kg /animal)	20.01±0.66	21.65±1.38	24.75±2.16	0.09
Average daily dry matter consumed(kg/ animal)	233±0.007	254±0.016	292±0.025	0.09
Feed to gain ratio	7.23±0.38	6.47±0.55	6.50±0.39	0.449 <sup>ns</sup>

\*Means bearing different superscripts (a,b) within a row differ significantly ( $p < 0.05$ )

Similarly, Bampidis et al. (2005a, 2005b) found no effect on FCR in lambs fed garlic bulb or dried oregano leaves. In contrast, Toghiani et al. (2010) found improved FCR in broilers fed black cumin seeds, and Aderinboye et al. (2021) reported linear improvements in FCR in goats fed turmeric at 2.5 and 5 g/day compared to control.

## Digestibility of Nutrients

Dry matter digestibility was significantly higher ( $p < 0.05$ ) (Table 3) in cumin-incorporated diets (T2, T3) and can be attributed to increased bile acid synthesis and enzymatic activities (Platel and Srinivasan, 2004). Similar trend was reported by El-Essawy et al. (2019), though contrasting results were

observed by Smeti et al. (2015). CP digestibility was showing significantly higher values ( $p < 0.01$ ) in T2 and T3. This is supported by Aderinboye et al. (2021) and Modi et al. (2022) where as Sahraei et al. (2014) observed no effect of rosemary essential oil on CP digestibility.

Crude fiber digestibility was significantly higher in T2 and T3 compared to T1, likely due to the mineral content (iron and zinc) in cumin seeds enhancing rumen microbial activity (Khan and Chaudhry, 2010; Milan et al., 2008). Similar improvements were reported by Zanouny et al. (2013) and Mishra et al. (2020), but Oloche et al.

(2013) found no significant change with orange peel meal supplementation. Ether extract digestibility was similar across all the treatments. El-Naggar et al. (2016) observed similar findings where as Aderinboye et al. (2021) found significant improvement with turmeric supplementation. NDF digestibility was similar in all treatments for T1, T2, and T3, respectively. Sahraei et al. (2014) reported similar results, while Ikyume et al. (2020) found significantly higher digestibility with ginger and garlic powder supplementation. Finally, ADF digestibility was significantly higher ( $p < 0.05$ ) in T2 and T3 compared to T1. Similar findings were reported by Mir and Kumar (2012).

Table 3. Apparent digestibility coefficient (%) of nutrients of experimental kids

Parameters	T1	T2	T3	pvalue
Initial bodyweight(kg)	5.41±0.35	5.35±0.39	5.66±0.61	0.881
Final bodyweight(kg)	8.20±0.39	8.76±0.49	9.55±0.91	0.342
Total weight gain (kg)	2.78 <sup>b</sup> ±0.08	3.41 <sup>ab</sup> ±0.25	3.88 <sup>a</sup> ±0.39	0.04*
Average daily gain (g)	33.13 <sup>b</sup> ±1.03	40.67 <sup>ab</sup> ±3.01	46.23 <sup>a</sup> ±4.75	0.04*
Total dry matter consumed (kg /animal)	20.01±0.66	21.65±1.38	24.75±2.16	0.09
Average daily dry matter consumed(kg/ animal)	233±0.007	254±0.016	292±0.025	0.09
Feed to gain ratio	7.23±0.38	6.47±0.55	6.50±0.39	0.449 <sup>ns</sup>

\*Means bearing different superscripts (a,b) within a row differ significantly ( $p < 0.05$ )

### Techno economics

The cost of production per kg body weight was higher in the control group (T1) compared to those fed 10% (T2) and 20% (T3) spent cumin seeds, primarily due to the lower cost of cumin seeds (Rs

5/kg) and improved growth in the supplemented groups (Table 4). Statistically, the cost per kg weight gain was comparable across all groups. Similar trends were reported by Zanouny et al. (2013) in sheep fed *Nigella sativa*.

Table 4. Techno economics of production of experimental kids

Parameter	T1	T2	T3	pvalue
Average complete feed intake(kg/kid)	21.31±0.70	23.37±1.49	26.52±2.31	0.112
Cost of complete feed/kg (Rs)	21.39	19.47	19.10	--
Total cost of feed(Rs./kid)	455.89±15.12	455.03±29.02	506.54±44.30	0.443
Total weight gain(kg/kid)	2.78 <sup>b</sup> ±0.087	3.41 <sup>ab</sup> ±0.25	3.88 <sup>a</sup> ±0.39	0.042*
Cost Rs/kg	164.87±8.82	136.09±11.64	133.12±8.10	0.065 <sup>ns</sup>

\*Means bearing different superscript (a,b)within a row differ significantly (p<0.05)

## CONCLUSION

The inclusion of spent cumin seeds at 10% and 20% in the diet of kids significantly improved average daily gain (ADG), feed conversion ratio (FCR), and nutrient digestibility, particularly for dry matter and crude protein. Additionally, the feed cost (Rs) per kilogram of body weight gain was reduced in the supplemented groups indicating that the 20% inclusion level proved to be a practical and economical strategy, enhancing growth performance and nutrient utilization without adverse effects.

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