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# Cumin (*Cuminum cyminum*): As a Feed Additive for Livestock

**AK Patil, RPS Baghel, S Nayak, CD Malapure, K Govil, D Kumar and Pavan Kumar Yadav**

**Abstract**
Cumin is an annual herb and has been used since ancient times as medicine and spices in food. Supplementation of cumin could either influence the feeding pattern or growth of favorable microorganisms in the rumen or stimulate the secretion of various digestive enzymes, which in turn may improve the efficiency of nutrients utilization or stimulate the milk secretary tissues in mammary glands resulting in improved milk production and reproductive performance of dairy animals. It has various pharmacological effects; recently the use of cumin has gained popularity because of herbal movement initiated by naturopaths, yog gurus, alternative medicine promoters and feed additives. Animal nutritionist is trying to exploit the potential use of cumin as a growth promoter, efficiency of nutrient utilization and mitigation of greenhouse gas emission. This review highlights the potential use of cumin as feed additive to increase production efficiency for effective animal production and reproduction.

**Keywords:** Cumin, feed additive, livestock, pharmacological effects, seed spices

## 1. Introduction

Cumin (*Cuminum cyminum* Linn.) is an important commercial seed spice belonging to the family umbellifereae and known for its aroma, medicinal and therapeutic properties [1]. The plant is native to the Mediterranean region where it is cultivated extensively. It is commonly known as zeera/jeera in Hindi, is an annual herb and has been used since ancient times as medicine and spices in food. It is considered to be one of the most important spices and ranks second to black pepper [2]. India is the world's largest producer and consumer of cumin [3]. Many value-added products of cumin seeds like oleoresins of cumin seeds and cumin oil are also exported from India. This spice should not be confused with sweet cumin, which is a common name for anise (*Pimpinella anisum*) [4]. *Nigella sativa*, which is also frequently referred to as black cumin, is not related to cumin. World widely therapeutic uses of cumin have been experimentally validated. In Ayurveda cumin seeds are notably considered carminative, eupeptic, antispasmodic, astringent and are used for treating mild digestive disorders, diarrhea, dyspepsia, flatulence, colic, abdominal distension, edema, broncho-pulmonary disorders, puerperal disorders, analgesic and as a cough remedy [5]. Cumin has various actions like enhancing vision, strength and lactation [6]. Cumin seeds have been reportedly used for traditional treatment of toothache, dyspepsia, epilepsy and jaundice [7]. It has various pharmacological effects such as anti-diabetic, immunologic, anti-tumour and antimicrobial activities [8]. Essential oil of cumin acts as powerful external or internal antiseptic, an analgesic, anti-inflammatory, hemolytic, anti-enzymatic action, sedative, stimulants and stomachic's [9]. Iranian traditional medicine consider cumin as stimulant, carminative and astringent and its therapeutic effects have been described on gastrointestinal, gynecological and respiratory disorders and also for the treatment of toothache, diarrhea and epilepsy [10]. In traditional medicine of Tunisia, cumin is considered abortive, galactagogue, antiseptic, antihypertensive herb, while in Italy; it is used as bitter tonic, carminative and purgative [11]. Therefore, it is clear that cumin as feed additives have many beneficial effects due to its aforesaid properties. Research has showed that the use of chemical additives especially antibiotics in animal nutrition may result in the accumulation of chemical residues in animal products [12]. Therefore, the use of organic feed additives in animal nutrition has gained more attention during recent years due to concerns about food safety and human health issue.

## 2. Composition

Cumin seed contains several nutrients including moisture (7%), volatile oil (3-4%), protein (12%), total ash (10%), fiber (11%), carbohydrate (33%), starch (11%) and fat (15%) [13]. Its nutrients composition varies according to the region and climate condition where it is grown. Typical cumin flavor is due to the volatile oil present in the seeds in the range of 3-4% depending on the variety and the origin of the cultivation. The cumin seeds contain 14.5% total lipids on dry weight basis which is consisted of 84.8% neutral lipid, 10% glycolipids and 5.1% phospholipids. Fatty acid composition of cumin includes both saturated and unsaturated fatty acids mainly (70% of total) oleic, petroselenic and linoleic acids [14]. Cumin essential oil contains several compounds namely cumin aldehyde, β-pinene, p-cymene and γ-terpinene [15]. Good amount of phenolic compounds show considerable radical scavenging carotene/ linoleic acid chelating and reducing power activities [16].

## 3. Effect of cumin supplementation on the performance of animals

### 3.1 Effect on nutrient utilization and methane mitigation

Livestock contributes about 18% to the global anthropogenic greenhouse gas (GHG) emissions, accounting for about 37% of the total anthropogenic methane and 65% of global anthropogenic nitrous oxide [17]. Ruminant livestock such as cattle can produce up to 200 L of methane per day which is regarded as a significant threat to the environment. Now a day's more emphasis is given for reducing methane from ruminants because eructation of methane from ruminants may contribute to the climatic change and global warming [18]. Moreover, ruminant animals lose about 2-12% of their dietary gross energy as methane which affects the nutrient efficiency and significantly contributes to the greenhouse gas emissions. Spices that have long been safely used for human consumption could be tested as alternatives to reduce enteric methane from livestock. Some spices are rich in tannins or saponins or polyphenolics and others are high in fatty acids [19]. Several researchers [20, 21] have used plant extracts to manipulate rumen fermentation for improving nutrient utilization and minimizing methane emission.

Number of researcher has proved that the inclusion of cumin increase digestibility of nutrients and enhance nutrient utilization additionally, it has potential to reduce methane emission from ruminants [22, 23]. Contrary, Miri *et al.* [24] observed that the DMI and milk composition were unaffected after addition of cumin seed in the ration, indicating no negative effect of cumin seed on palatability of the ration.

Additions of cumin have potential to reduced methane to the extent of 22% in buffered rumen fluid, *in vitro* observed that there was 11.8% reduction in methane emission of goats when diet supplemented with cumin seed extract [25]. This effect might be due to inhibitory effect of cumin seed extract on ruminal microbial biomass. Suppression of growth of ruminal Gram-positive $H_2$ producing bacteria can reduce the amount of available hydrogen for biohydrogenation as well as methanogensis. The loss of protozoa would be expected to impact positively on the availability of CLA to host animal and negatively on methane emission [26].

Supplementing broiler diet with cumin oil has significantly increased body weight as compared with control [27]. Ali *et al* [28] reported that negative effects of heat stress can be alleviated and growth performance can be improved by adding 2% cumin in diet of heat stressed broiler. Galib and Al-Kassi [29] reported that adding cumin and turmeric mixture at levels of 0.75% and 1% in the diets improved body weight gain, feed intake and feed conversion ratio in broilers, which could be due to role of cumin as a stimulant, carminative, digestion, antimicrobial properties and the prevention of gastric toxicity. Other researchers proved that there is an increase in body weight, feed conversion ratio with decreasing hematological values of some important blood parameters using 2% of cumin in broiler diets [30].

### 3.2 Effect on milk quantity and quality

Sustainable dairy farming necessitates new approaches to improve milk production efficiency. The need for more efficient production systems is growing due to the ongoing increases in the costs of production particularly those of feedstuff in developing countries such as India. Cumin is a constituent of herb Payapro a known galactagogue. Bhatt *et al.* [31] also reported galactapoiesis property. The addition of cumin seed extract (1.27% of DM) significantly ($P<0.05$) enhanced milk production by 13% in supplemented goat in comparison to control group [24]. Cumin seed extract (CSE) supplementation had no any adverse effect on milk fat, protein and lactose percentage, however, C18:3-n3, C18:2n-6c, C18:1 trans-11, monounsaturated fatty acids, polyunsaturated fatty acids (PUFA) and ratio of polyunsaturated to saturated fatty acids content of milk increased significantly ($P<0.05$) when additive was used [32]. The cis-9 trans-11 conjugated linoleic acid (CLA) significantly ($P<0.01$) increased by 20% in goat milk receiving the CSE supplemented diet. Delta-9-desaturase index in CSE added groups was significantly ($P<0.01$) higher in comparison to control. In addition, goats which were fed with 1g/L CSE produced milk with higher recovery of linoleic acid (LA) and linolenic acid (LNA) [32] . Polyphenols (tannins and non-tannins) have ability to affect fatty acid metabolism at different steps of ruminal biohydrogenation [33]. Bettaieb *et al.* [34] observed that cumin contains an unusual fatty acid like petroselinic acid (C18:1n-12)) and part of the increase in the concentration of LA in goat milk fed CSE might be attributed to the presence of petroselinic acid, that has been shown to inhibit conversion of LA to arachidonic acid [35]. Likewise, Ghafari *et al.* [36] observed that the supplementation of cumin seed @ 0, 100, 200 and 300 g/cow/d have potential to enhanced ($P \leq 0.05$) milk yield curvilinearly with level of cumin seed (average 47.9, 52.5, 55.1 and 53.6 kg/d for the four levels, respectively). The yield of milk components was similar to milk yield ($P \leq 0.05$) except for fat and 4% fat-corrected milk yields, which were not significantly affected by the treatments.

### 3.3 Effect on antioxidant status

Free radicals are highly reactive species having unpaired electrons in their outermost shell [37]. Higher production of free radicals in the body can causes oxidative stress that ultimately leads to oxidative damage to important biomolecules, leading to many chronic diseases [38]. To cope up with these radicals the living system has antioxidant enzymes defense system or animal may takes antioxidants through diet as vitamins and minerals. Number of studies conducted in India showed that cumin oils exhibited high antioxidant activity due to flavonoids particularly apigenin and luteolin of cumin seeds [39]. Gangandeep [40] reported that supplementation of cumin seed (2.5 and 5% of diet) in mice tended to increase superoxide dismutase, catalase and reduced glutathione however, the activities of glutathione peroxidase and glutathione reductase remained unaltered by both doses of cumin. Similarly, cuminaldehyde has been demonstrated to scavenge the superoxide anion [41]. Further it confirmed by Juhainmi and Ghafoor [42] that the supplementation of cumin seed extracts has higher DPPH radical scavenging activities in comparison to unsupplemented animals and the antioxidant activity of cumin seed extracts ranged from 8.25 to 11.24 mg/mL. They stated that the antioxidative potential increased with increase of phenolic compounds content of cumin. Food materials rich in bioactive compounds with higher free radical scavenging abilities are protective against certain types of cancer and may also reduce the risk of cardiovascular and cerebrovascular disorders in human being [43].

### 3.4. Antimicrobial activity

The major compounds in all cumin oils were the monoterpenes beta-pinene, p-cymene, gamma-terpinene, terpenoid aldehydes cuminic aldehyde and isomeric menthadien carboxaldehydes [44]. Cumin essential oil showed antibacterial activity comparable with standard antibiotics against common pathogens. Cuminaldehyde demonstrated antimicrobial and antifungal properties against *E. coli, P. chrysogenum, A. flavus* and *A. niger* [45]. Similarly, Jirovets *et al.* [46] also reported anti-microbial activity of cumin essential oil against molds (*A. niger*), gram positive bacteria (*B. subtilis, S. epidermidis*), gram negative bacteria (*E. coli*) and yeast (*S. cerevisiae* and *C. albicans*). Jazani *et al.* [47] indicated the potential use of cumin essential oil for the control of some diseases caused by *P. aeruginosa* infections. Cumin oil and cuminaldehyde have been reported to exhibit strong larvicidal and antibacterial activity. At *in vitro* concentrations of 300 or 600 ppm, cumin oil inhibited the growth of *Lactobacillus plantarum* [48]. Antifungal activity of cumin oil is recorded against soil, food, animal and human pathogens, including dermatophytes, *Vibrio* spp., yeasts, aflatoxins and mycotoxin producers [49, 50, 51].

### 3.5 Immunomodulatory effect

Oral treatment with cumin caused modulation of T-lymphocyte's expression in a dose dependent manner in normal and immune suppressed animals. It stimulated the T-cell's ($CD_4$ and $CD_8$) and Th-1 cytokine's expression in normal and cyclosporine-A induced immune suppressed mice. In stress induced immune suppressed animals the active compound of cumin countered the depleted T lymphocytes, decreased the elevated corticosterone levels and size of adrenal glands and increased the weight of thymus and spleen [52].

### 3.6 Estrogenic/anti-osteoporotic effect

Cumin seeds content phytoestrogens which is responsible for estrogenic and anti-osteoporotic property [53]. Administration of cumin extract in animals resulted in reduced urinary calcium excretion and increased calcium content and bone strength. Bone and ash densities along with improved microarchitecture with no adverse effects were reported after supplementation of cumin in animal [54].

### 3.7 Anticarcinogenic/antimutagenic

Gangandeep *et al.* [40] observed that cumin seeds were able to inhibit the induction of gastric squamous cell carcinomas in mice. Similarly, in rats fed with cumin has a protective effect against induced colonic cancer, decreased beta-glucuronidase and mucinase activity have been demonstrated [55]. Dietary cumin inhibited benzopyrene-induced forestomach tumorigenesis, 3-methylcholanthrene induced uterine cervix tumorigenesis and 3-methyl-4- dimethyaminoazobenzene induced hepatomas in mice [56, 57]. This was attributed to the ability of cumin in modulating carcinogen metabolism via carcinogen/xenobiotic metabolizing phase I and phase II enzymes. Activities of cytochrome (CYP) P-450 reductase and CYP b5 reductase were augmented whereas phase II enzymes GST and DT-diaphorase were increased [58].

### 3.8 Antidiabetic effect

The antidiabetic effects of cumin are well documented [59]. In a glucose tolerance test in rabbits, cumin significantly increased the area under the glucose tolerance curve and hyperglycemic peak [60]. Diet containing cumin powder (1.25%) was found to be remarkably beneficial in streptozotocin induced diabetic rats as indicated by reduction in hyperglycemia and glucosuria, improved body weights, lowered blood urea level and reduced excretions of urea and creatinine by diabetic animals [61]. Cumin at (0.5% g) per kg body weight orally administered in rats with induced diabetes is reported reduce blood glucose levels [62]. It might be due to inhibition of aldose reductase and alpha-glucosidase [63].

## 4. Conclusion

Cumin is one of the commercially important seed spices and forms one of the ingredients of many spice mixes which are consumed in our daily diet. *Cuminum cyminum* contained alkaloid, coumarin, anthraquinone, flavonoid, glycoside, protein, resin, saponin, tannin and steroid. Its fatty acid composition and cumin oleoresin has rich in unsaturated fatty acids mainly linoleic acid which is known to possess health benefits. Flavanoids like apigenin, luteolin and glycosides present in cumin are reported to be responsible for many of the biological activities of cumin. Cumin acts as antimicrobial, insecticidal, anti-inflammatory, analgesic, antioxidant, anticancer, antidiabetic, antiplatelet aggregation, hypotensive, bronchodilatory, immunological, anti-amyloidogenic and anti-osteoporotic effects etc. From the review, it is concluded that cumin as feed additives is included in small quantities in the diet to improve nutrient utilization and production efficiency without any adverse impact on animals.

## 5. Acknowledgement

We declare that we have no conflicts of interest.

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