Literature Survey
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Gupta RS et al; (2011) evaluated the contraceptive efficacy of *Cuminum cyminum* (jeera) seeds methanol extract in male albino rats at dose levels of 100 and 200 mg/rat/day orally for 60 days. The effect of the treatment on reproductive organs and fertility was investigated. Recovery and toxicity studies were also carried out. They reported that extract fed to male rats for 60 days did not cause any alterations in the body weight, whereas the weight of testes, epididymides, seminal vesicles and ventral prostate were significantly reduced. Animals showed a marked reduction in sperm density in the cauda epididymis and testes and sperm motility in the cauda epididymis. Reduction in fertility was 69.0% and 76.0% in 100 and 200 mg/rat/day dose levels, respectively. The circulatory hormones were also reduced significantly. Testicular biochemical analysis of protein, sialic acid, glycogen, ascorbic acid and fructose indicated a marked decline, whereas testicular cholesterol content was significantly increased, which showed altered biochemistry of the reproductive organs. After extract treatment, significant decreases were observed in the number of testicular cells [i.e., spermatogonia, primary spermatocytes (preleptotene and pachytene), secondary spermatocytes and round spermatids]; nonsignificant change was observed in the Sertoli cell count. The treatment had no effect on levels of serum protein, cholesterol, bilirubin, glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), blood urea and hematological indices. They concluded that *C. cyminum* treatment resulted in the inhibition of spermatogenesis and fertility without producing apparent toxic effects.

Koppula S and Choi DK; (2011) reported that *Cuminum cyminum* Linn. is a popular spice with a long history of medicinal use to treat various symptoms such as diarrhea, flatulence, gynecological, and respiratory diseases. Objective: To date, no scientific investigation was reported regarding memory-enhancing and antistress activity of cumin fruits. They provided scientific support for the antistress, antioxidant, and memory-enhancing activities of cumin extract and told that its traditional use as a culinary spice in foods is beneficial and scientific in combating stress and related disorders.
Makchuchit S et al; (2010)\textsuperscript{130} investigated nineteen Thai medicinal plants used in Thai traditional medicine preparation to treat colds, asthma and fever were studied for their antioxidant and NO inhibitory activities. They obtained three extracts from each plant. First extract obtained by macerating the plant part in 95% ethanol (Et) residue was boiled in water, where water extract (EW) was obtained. The third extract (HW) was obtained by boiling each plant in water similar to that of Thai traditional medicine practice. These extracts were tested for their antioxidant activity using DPPH assay, and anti-inflammatory activity by determination of inhibitory activity on lipopolysaccharide (LPS) induced nitric oxide (NO) production in RAW 264.7 cell lines using Griess reagent. Potent inhibitory activity on lipopolysaccharide (LPS) induced nitric oxide (NO) production in RAW 264.7 cells, with IC\textsubscript{50} value of 13.56 microg/ml for \textit{Cuminum cyminum}. They concluded that anti-inflammatory activity of these plants correspond with the traditional use for fever; cold, allergic-related diseases and inflammatory-related diseases.

Pai MB et al; (2010)\textsuperscript{131} evaluated the \textit{in vitro} antifungal efficacy of \textit{Cuminum cyminum} on Candida albicans. They told that the potential use of this product as cheap and convenient adjuvants to pharmaceutical antifungal products.

Wanner J et al; (2010)\textsuperscript{132} analyzed Cumin oil samples (\textit{Cuminum cyminum} L.) from four different geographical origins by using GC-MS and GC-FID for their qualitative and quantitative composition. The major compounds in all cumin oils were the monoterpenes beta-pinene, p-cymene and gamma-terpinene and the terpenoid aldehydes cuminic aldehyde and the isomeric menthadien carboxaldehydes. All essential oils, and cuminic aldehyde, were tested, using agar diffusion and serial dilution methods, against different Gram-positive and Gram-negative bacteria isolated from different sources of food (pork fillet, minced meat and sausages) and clinical isolates, as well as three different Candida albicans isolates. All cumin oils and cuminic aldehyde exhibited a considerable inhibitory effect against all the organisms tested, except Pseudomonas spp.

Sultana S et al; (2010)\textsuperscript{133} reported that spices have been shown to impart an antioxidative effect in foods. They summarized the literature on the antioxidative
effects of spices. The methanolic crude extracts of *Cuminum cyminum*, was screened for their free radical scavenging properties using ascorbic acid as standard antioxidant. Free radical scavenging activity was evaluated using 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical. The overall antioxidant activity of *Cuminum cyminum* was found to be the strongest, followed in descending order by *Z. officinale*, *C. sativum*, *A. sativum*, *C. tamala*, *C. verum*, *E. cardamomum*. The IC50 values of the extracts ranged between 15.48 and 217.43 (μg mL(-1)). The ascorbic acid levels was 22.78 (μg mL(-1)) the present study revealed that the selected plants would exert several beneficial effects by virtue of their antioxidant activity and could be harnessed as drug formulation.

Bettaieb I et al; (2010) investigated *Cuminum cyminum* L. roots, stems and leaves, and flowers for their essential oils, total phenolics, flavonoids, and tannins contents, individual phenolic compounds, and antioxidant activities. The essential oil was investigated by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS), whereas identification and quantification of individual target polyphenolic compounds was performed by reversed-phase high-performance liquid chromatography (RP-HPLC). Essential oil yields were 0.03% in roots, 0.1% in stem and leaves, and 1.7% in flowers. Major components of the oils were bornyl acetate (23%), α-terpinene (34%), and γ-terpinene (51%) in roots, stems and leaves, and flowers, respectively. In all *C. cuminum* organs, total phenolics content ranged from 11.8 to 19.2 mg of gallic acid equivalents per gram of dry weight (mg of GAE/g of DW). Among the polyphenols studied, 13 were identified in roots, 17 in stem and leaves, and 15 in flowers. The major phenolic compound in the roots was quercetin (26%), whereas in the stems and leaves, p-coumaric, rosmarinic, trans-2-dihydrocinnamic acids and resorcinol were predominant. In the flowers, vanillic acid was the main compound (51%). The antioxidant activities of *C. cuminum* essential oils and acetone extracts obtained from the three organs were assessed using four tests [1,1-diphenyl-2-picrylhydrazyl (DPPH), β-carotene/linoleic acid, reducing power, and chelating power assays]. The acetone extract of flowers was strongly effective as a DPPH radical scavenger, lipid peroxidation inhibitor, and reducing agent, with IC(50) values of 4, 32, and 8 μg/mL, respectively. Moreover, the acetone
extract of stems and leaves showed the highest chelating power. However, the essential oils exhibited moderate activities in the different tests.

Romagnoli C et al; (2010)\textsuperscript{135} analyzed the essential oil of fruits of \textit{Cuminum cyminum} L. (Apiaceae), from India, by GC and GC-MS, and its antifungal activity was tested on dermatophytes and phytopathogens, fungi, yeasts and some new Aspergilli. The most abundant components were cumin aldehyde, pinenes, and p-cymene, and a fraction of oxygenate compounds such as alcohol and epoxides. Because of the large amount of the highly volatile components in the cumin extract, we used a modified recent technique to evaluate the antifungal activity only of the volatile parts at doses from 5 to 20 microL of pure essential oil. Antifungal testing showed that \textit{Cuminum cyminum} is active in general on all fungi but in particular on the dermatophytes, where Trichophyton rubrum was the most inhibited fungus also at the lowest dose of 5 microL. Less sensitive to treatment were the phytopathogens.

Allahghadri T et al; (2010)\textsuperscript{136} reported that Cumin (\textit{Cuminum cyminum}) is used in traditional medicine as a stimulant, a carminative, and an astringent. In this study, he characterized the antimicrobial, antioxidant, and cytotoxic activities of cumin. E. coli, S. aureus, and S. faecalis were sensitive to various oil dilutions. The total phenol content of the essential oil was estimated to be 33.43 microg GAE/mg of the oil. The oil showed higher antioxidant activity compared with that of BHT and BHA. The cumin essential oil exhibited a dose-dependent scavenging of DPPH radicals and 5.4 microg of the oil was sufficient to scavenge 50\% of DPPH radicals/mL. At a concentration of 0.1 microL/mL, oil destructed Hela cells by 79\%. The antioxidant activity of cumin essential oil might contribute to its cytotoxic activity. Acute and subchronic toxicity was studied in a 30-days oral toxicity study by administration to Wistar rats of the essential oil. A 17.38\% decrease in WBCs count, and 25.77\%, 14.24\%, and 108.81\% increase in hemoglobin concentration, hematocrit, and platelet count, respectively, were noted. LDL/HDL ratio was reduced to half, which adds to the nutritional effects of cumin. They concluded that cumin with a high phenolic content and good antioxidant activity can be supplemented for both nutritional purposes and preservation of foods.
Jagtap AG and Patil PB; (2010)\textsuperscript{137} investigated the effect of methanolic extract of seeds of C. cyminum (CC) on diabetes, oxidative stress and formation of advanced glycated end products (AGE) and obtain comparison with glibenclamide. \textit{In vitro} studies indicated that CC inhibited free radicals and AGE formation. Treatment of streptozotocin-diabetic rats with CC and glibenclamide for 28 days caused a reduction in blood glucose, glycosylated hemoglobin, creatinine, blood urea nitrogen and improved serum insulin and glycogen (liver and skeletal muscle) content when compared to diabetic control rats. Significant reduction in renal oxidative stress and AGE was observed with CC when compared to diabetic control and glibenclamide. CC and glibenclamide improved antioxidant status in kidney and pancreas of diabetic rats. Diabetic rats showed increase in rat tail tendon collagen, glycated collagen, collagen linked fluorescence and reduction in pepsin digestion. Treatment with CC significantly improved these parameters when compared to diabetic control and glibenclamide group. Though the antidiabetic effect of CC was comparable to glibenclamide it had better effect in controlling oxidative stress and inhibiting the AGE formation, which are implicated in the pathogenesis of diabetic microvascular complications.

Chauhan PS \textit{et al}; (2010)\textsuperscript{138} published that many herbs and spices are known to modulate the immune system and have been shown to restore the immunity in immuno-compromised individuals. Spices generally used to increase the taste and flavor of food also has the history of usage as an ayurvedic medicine. They explored the health modulating effects of \textit{Cuminum cyminum} and to identified the active compound, immunomodulatory properties were evaluated using flowcytometry and ELISA in normal and immune-suppressed animals. C. cyminum and compound 1 stimulated the T cells and Th1 cytokines expression in normal animals. Swiss albino mice subjected to Cyclosporine-A induced immune-suppression were dosed orally with C. cyminum (25, 50, 100 and 200 mg/kg) on consecutive days. The results showed that administration significantly increased T cells (CD4 and CD8) count and Th1 predominant immune response in a dose dependent manner thereby suggesting immunomodulatory activity through modulation of T lymphocytes expression. In restraint stress induced immune-suppressed animals, compound 1 countered the
depleted T lymphocytes, decreased the elevated corticosterone levels and size of adrenal glands and increased the weight of thymus and spleen. Based on the data they concluded that C. cyminum is a potent immunomodulator and may develop as a lead to recover the immunity of immuno-compromised individuals.

Nickavar B and Abolhasani FA; (2009) investigated antioxidative activities [IC(50)] of ethanol extracts from seven Umbelliferae fruits (Bunium persicum, Coriandrum sativum, Cuminum cyminum, Foeniculum vulgare, Heracleum persicum, Pimpinella anisum and Trachyspernum copticum) by the DPPH (2,2'-diphenyl-1-picrylhydrazyl) radical scavenging test. All the studied extracts showed antioxidant capability and P. anisum extract exhibited the strongest activity. The scavenging activity of the extracts in decreasing order was: P. anisum > T. copticum > C. cyminum > F. vulgare > or = B. persicum > or = H. persicum. The extracts were also investigated regarding their total flavonoid contents by the AlCl3 technique. The decreasing order of the flavonoid content of the extracts was: C. cyminum > T. copticum > P. anisum > or = H. persicum > or = B. persicum > or = F. vulgare > or = C. sativum. However, a favorable correlation was not found between the antioxidant activity and the total flavonoid content of the extracts. As well, the most active extract (i.e. P. anisum) was partitioned with n-hexane, chloroform and ethyl acetate to yield three organic fractions together with the remaining aqueous fraction. The antioxidative activities (IP%) and flavonoid contents of the fractions were also determined. The ethyl acetate fraction exhibited the highest activity and content. A positive correlation was reported between the antioxidant potency and flavonoid content of the fractions.

Said O et al; (2008) prepared and assessed Weighlevel, a mixture of extract of four plants used in traditional Arabic and Islamic medicine as well as in European herbal medicine, was for its safety and efficacy in weight loss. Leaves of Alchemilla vulgaris, Olea europaea and Mentha longifolia, as well as seeds of Cuminum cyminum, were used. Cultured human fibroblasts treated with Weighlevel did not exhibit any sign of toxicity as evidenced by lactate dehydrogenase release. These results were confirmed in experimental studies on rats where an LD(50) of 15.3 g kg(-1) was observed. Significant antioxidant properties were seen at very low
concentrations of Weighlevel (10 microg ml(-1)) as measured by the lipid peroxidation method. Progressive and significant weight loss was observed in chickens given this mixture weekly for 4 weeks compared with controls. Furthermore, a 3-fold increase in the thermogenesis was seen in rat interscapular brown adipose tissue following exposure to different concentrations of Weighlevel extract as determined by measurement of increased oxygen consumption. In addition, a clinical study was carried out among 80 human volunteers with a body mass index (BMI) of 30.67 +/- 2.14 kg m(-)(2). All 80 subjects were asked to continue their usual diet but to eat only three main meals daily and to take one Weighlevel tablet 30 min before each meal. Fourteen subjects were excluded for not following the protocol, and 66 subjects were all evaluated for efficacy and tolerability of Weighlevel monthly for 3 months. Weigh level was well tolerated by all subjects, and no side effects were reported. A progressive and significant weight loss was seen in these subjects during the whole study period. Higher levels of weight loss were seen in people with BMI of 25-30 kg m(-)(2) (overweight) compared to people with BMI >30 kg m(-)(2) (obese). The BMI was reduced after 3 months from 28.5 +/- 1.2 and 32.1 +/- 1.8 kg m(-)(2) to 24.5 +/- 1.4 and 27.5 +/- 2.2 kg m(-)(2) in overweight and obese group, respectively. Results indicated safety, tolerability and efficacy formulation.

Khatibi A et al; (2008) investigated the effects of Cuminum cuminum fruit essential oil (FEO) on the acquisition and expression of morphine-induced conditioned place preference (CPP) in mice. CPP was induced by subcutaneous (s.c.) injection of morphine (5mg/kg) in 3 days conditioning schedule. Intraperitoneal (i.p.) administration of Cumin FEO (0.001%, 0.01%, 0.1%, 0.5%, 1% and 2%; 5 ml/kg) or Tween-80 (0.5%; 5 ml/kg) did not show any conditioning effects. Administration of Cumin FEO (0.001-2%; 5 ml/kg; i.p.), 60 min before test on day 5 (expression) decreased the conditioning scores at the doses of 1% and 2% while i.p. injection of Cumin FEO (0.001-2%; 5 ml/kg), 60 min before morphine injection (5mg/kg; s.c.) during 3 days of conditioning session (acquisition) significantly resulted in decrement of rewarding properties of morphine at the doses of 0.1%, 0.5%, 1% and 2% in dose-dependent manner. Tween-80 as a vehicle did
not suppress the acquisition and expression of morphine-induced CPP. The results showed that the C. cyminum fruit essential oil reduces the acquisition and expression of morphine-induced conditioned place preference in mice.

Shirke SS et al; (2008) performed anti-osteoporotic evaluation of phytoestrogen-rich plant *Cuminum cyminum*. Adult Sprague-Dawley rats were bilaterally ovariectomized (OVX) and randomly assigned to 3 groups (10 rats/group). Additional 10 animals were sham operated. OVX and sham control groups were orally administered with vehicle while the other two OVX groups were administered 0.15 mg/kg estradiol and 1 g/kg of methanolic extract of *Cuminum cyminum* fruits (MCC) in two divided doses for 10 weeks. At the end of the study blood, bones and uteri of the animals were collected. Serum was evaluated for calcium, phosphorus, alkaline phosphatase and tartarate resistant acid phosphatase. Bone density, ash density, mineral content and mechanical strength of bones were evaluated. Scanning electron microscopic (SEM) analysis of bones (tibia) was performed. Results were analyzed using ANOVA and Tukeys multiple comparison test. MCC (1 g/kg, p.o.) significantly reduced urinary calcium excretion and significantly increased calcium content and mechanical strength of bones in comparison to OVX control. It showed greater bone and ash densities and improved microarchitecture of bones in SEM analysis. Unlike estradiol it did not affect body weight gain and weight of atrophic uterus in OVX animals. MCC prevented ovariectomy-induced bone loss in rats with no anabolic effect on atrophic uterus. The osteoprotective effect was comparable with estradiol.

Kumar PA et al; (2009) reported that alpha-Crystallin, a molecular chaperone of the eye lens, plays an important role in maintaining the transparency of the lens by preventing the aggregation/inactivation of several proteins and enzymes in addition to its structural role. Alpha-Crystallin is a long-lived protein and is susceptible to several posttranslational modifications during aging, more so in certain clinical conditions such as diabetes. Nonenzymatic glycation of lens proteins and decline in the chaperone-like function of alpha-crystallin have been reported in diabetic conditions. Therefore, inhibitors of nonenzymatic protein glycation appear to be a potential target to preserve the chaperone activity of alpha-crystallin and to combat
cataract under hyperglycemic conditions. In this study, we investigated the antiglycating potential of cumin *in vitro* and its ability to modulate the chaperone-like activity of alpha-crystallin vis-à-vis the progression of diabetic cataract *in vivo*. Aqueous extract of cumin was tested for its antiglycating ability against fructose-induced glycation of goat lens total soluble protein (TSP), alpha-crystallin from goat lens and a nonlenticular protein bovine serum albumin (BSA). The antiglycating potential of cumin was also investigated by feeding streptozotocin (STZ)-induced diabetic rats with diet containing 0.5% cumin powder. The aqueous extract of cumin prevented *in vitro* glycation of TSP, alpha-crystallin and BSA. Slit lamp examination revealed that supplementation of cumin delayed progression and maturation of STZ-induced cataract in rats. Cumin was effective in preventing glycation of TSP and alpha-crystallin in diabetic lens. Interestingly, feeding of cumin to diabetic rats not only prevented loss of chaperone activity but also attenuated the structural changes of alpha-crystallin in lens. They told that cumin has antiglycating properties that may be attributed to the modulation of chaperone activity of alpha-crystallin, thus delaying cataract in STZ-induced diabetic rats.

Bukhari SB *et al*; (2009)\(^{144}\) investigated antioxidant activity of cumin. Extracts of cumin were prepared in methanol, ethanol, dichloromethane and hexane by employing Soxhlet extraction apparatus. Determination of the total phenolic content, chelating activity, reducing power and free radical scavenging activity were taken as parameters for the assessment of antioxidant properties. The findings of this study suggested cumin to be a potent source of antioxidants.

Haghparast A *et al*; (2008)\(^{145}\) investigated the effects of fruit essential oil (FEO) of *Cuminum cyminum* on acquisition and expression of morphine tolerance and dependence in mice. Animals were rendered dependent on morphine using the well-established method in which was morphine (50, 50, 75 mg/kg; s.c.) injected three times daily for 3 days. In experimental groups, administration of FEO (0.001, 0.01, 0.1, 0.5, 1 and 2%; 5 ml/kg; i.p.) or Tween-80 (5 ml/kg; i.p.) was performed 60 min prior to each morphine injection (for acquisition) or the last injection of morphine on test day (for expression). Morphine tolerance was measured by tail-flick before and after administration of a single dose of morphine (50 mg/kg; s.c.) in test day (4th
Morphine dependence was also evaluated by counting the number of jumps after injection of naloxone (5 mg/kg; i.p.) on the test day. The results showed that Cumin FEO, only at the dose of 2%, significantly attenuated the development of morphine tolerance (P<0.01) and dependence (P<0.05) while it could be significantly effective on expression of morphine tolerance (1 and 2%) and dependence (0.5, 1 and 2%) in a dose-dependent manner. Solely Cumin FEO injection (0.001-2%) did not show any analgesic effect. They concluded that the essential oil of *Cuminum cyminum* seems to ameliorate the morphine tolerance and dependence in mice.

Shayegh S *et al*; (2008) assessed antimicrobial activities and biofilm-formation preventive properties of Mentha piperita and *Cuminum cyminum* essential oils and chlorhexidine were assessed against Streptococcus mutans and Streptococcus pyogenes. Gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) analysis led to the identification of 26 and 32 compounds in the essential oils of *M. piperita* and *C. cyminum*, respectively. Minimal bactericidal concentrations (MBC) of the oils and chlorhexidine and microbial decimal reduction time (D value) were determined. Antibacterial and *in vivo* biofilm preventive efficacies of all the concentrations of *M. piperita* oil were significantly (p<0.001) higher. The biofilm inhibitory properties in planktonic cultures were in *M. piperita* > chlorhexidine > *C. cyminum* order. *In vivo* experiments conducted on male and female volunteers who brushed with essential oil blended toothpastes indicated that lower concentrations of the oils, in particular the *M. piperita* oil, were significantly higher (p<0.001) and effective during the course of the study as compared to chlorhexidine.

Suganthi R *et al*; (2007) reported that high fructose feeding in normal rats induces insulin resistance and also facilitates oxidative damage. The present study examines the effects of a spices mixture (SM) on oxidative stress markers and antioxidant potential in tissues of high fructose-fed insulin-resistant rats. Male Wistar rats received a semisynthetic diet containing either 60% fructose or 60% starch. SM administration at three different doses (10, 30, and 50 mg/day per rat) was initiated orally 15 days later and continued for the next 30 days. After the total experimental
period of 45 days, peroxidation of lipids and antioxidant status in liver and kidney were quantified. Fructose-treated rats showed increased levels of peroxidation indices such as thiobarbituric acid-reactive substances and lipid hydroperoxides in tissues. The condition was associated with an inadequate antioxidant system. Administration of SM along with fructose diet reduced the levels of peroxidation markers in tissues and improved the antioxidant status. The positive effect of SM on the oxidant-antioxidant balance could be attributed to the active constituents of the different spices present in the mixture.

Sachin BS et al; 2007)\textsuperscript{148} Investigated the pharmacokinetic interaction of some herbal products and a pure molecule isolated from *Cuminum cuminum* with Rifampin. They reported that an aqueous extract derived from cumin seeds produced a significant enhancement of Rifampin levels in rat plasma. This activity was found to be due to a flavonoid glycoside, 3',5-dihydroxyflavone 7-O-beta-D-galacturonide 4'-O-beta-D-glucopyranoside (CC-I). CC-I enhanced the Cmax by 35% and AUC by 53% of RIF. They concluded that altered bioavailability profile of RIF could be attributed to a permeation enhancing effect of this glycoside.

Nalini N et al; 2006)\textsuperscript{149} investigated the effect of red chilli (Capsicum annum L.), cumin (*Cuminum cyminum* L.), and black pepper (*Piper nigrum* L.) on colon cancer induced in rats by a colon-specific carcinogen, 1,2-dimethylhydrazine (DMH). Colon cancer was induced by subcutaneous injection of DMH at a dosage of 20 mg/kg of body weight (15 doses, at 1-week intervals). The rats were continued with the standard pellet diet and supplemented red chilli [C. annum L., 0.015% (wt/wt) mixed with the diet], cumin seeds [C. cyminum L., 1.25% (wt/wt) mixed with the diet], and black pepper [(P. nigrum L., 0.5% (wt/wt) mixed with the diet] throughout the experimental period. After the total experimental period of 32 weeks (including 2 weeks of acclimatization) the incidence and number of tumors in the colon were observed to be significantly higher in the rats administered DMH and/or red chillis, as compared with the cumin + DMH and black pepper + DMH groups. No tumors were observed in the control, cumin + DMH, or black pepper + DMH groups. The levels of fecal bile acids and neutral sterols in 24-hour fecal samples were significantly decreased in DMH + chilli-administered rats, while the excretion of
fecal bile acids and neutral sterols was significantly increased in cumin + DMH- and black pepper + DMH-administered rats. In DMH-, chilli-, and chilli + DMH-administered rats the levels of cholesterol, cholesterol/phospholipid ratio, and 3-hydroxy-3-methylglutaryl-CoA reductase activity were decreased in cumin + DMH- and black pepper + DMH-treated rats. The phospholipid levels were reduced in the DMH, chilli, and chilli + DMH groups as compared with the cumin + DMH and black pepper + DMH groups. There results showed that chilli supplementation promotes colon carcinogenesis, whereas cumin or black pepper suppresses colon carcinogenesis in the presence of the procarcinogen DMH.

Srinivasan K; (2005) published a review considers all the available information from animal experimentation as well as clinical trials where spices, their extracts or their active principles were examined for treatment of diabetes. They found that among the spices, fenugreek seeds (Trigonella foenumgraecum), garlic (Allium sativum), onion (Allium cepa), and turmeric (Curcuma longa) have been experimentally documented to possess antidiabetic potential. In a limited number of studies, cumin seeds (Cuminum cyminum), ginger (Zingiber officinale), mustard (Brassica nigra), curry leaves (Murraya koenigii) and coriander (Coriandrum sativum) have been reported to be hypoglycaemic.

Kode A et al; (2005) assessed the effect of ethanol and thermally oxidized sunflower oil ingestion on liver phospholipid fatty acids and the protective role of Cuminum cyminum L. They administered ethanol at a level of 20% and thermally oxidized sunflower oil at a level of 15% for 45 days. C. cyminum was administered at a dosage of 250 mg/kg body weight for 45 days. They investigated the changes in the liver phospholipid fatty acid composition. Ethanol and thermally oxidized sunflower oil administration modifies the fatty acid composition and the analysis of fatty acids showed that there was a significant increase in the concentrations of 16:0, 16:1, 18:0, 18:1 and 18:2, whereas the concentration of 20:4 was significantly decreased. The concentrations of 16:0, 16:1, 18:0, 18:1 and 20:4 were near normal in cumin-treated rats. They reported that cumin prevents the changes in the composition of fatty acids, which were produced by ethanol and thermally oxidized oil.
Nostro A et al; (2005) investigated the effect of either, ethanolic or aqueous extracts from 17 plant materials were studied against one H. pylori standard strain and 11 clinical isolates using a disc diffusion test and by evaluating the minimum inhibitory concentration (MIC) on solid media. An inhibitory activity against H. pylori strains was recorded in a large percentage of tested plants. MIC values of ethanolic extracts were from two to four concentration steps lower than the aqueous ones. In particular, ethanolic extracts of Cuminum cyminum L. and Propolis expressed MIC90 values of 0.075 mg/mL. The results showed a significant in vitro effect of plant extracts against H. pylori that could be considered a valuable support in the treatment of the infection and may contribute to the development of new and safe agents for inclusion in anti-H. pylori regimens.

Lee HS; (2005) investigated the inhibitory activity of Cuminum cyminum seed-isolated component against lens aldose reductase and alpha-glucosidase isolated from Sprague-Dawley male rats and compared to that of 11 commercially available components derived from C. cyminum seed oil, as well as quercitrin as an aldose reductase inhibitor and acarbose as an alpha-glucosidase inhibitor. The biologically active constituent of C. cyminum seed oil was characterized as cuminaldehyde by various spectral analyses. The IC(50) value of cuminaldehyde is 0.00085 mg/mL against aldose reductase and 0.5 mg/mL against alpha-glucosidase, respectively. Cuminaldehyde was about 1.8 and 1.6 times less in inhibitory activity than acarbose and quercititin, respectively. Nonetheless, cuminaldehyde may be useful as a lead compound and a new agent for antidiabetic therapeutics.

Iacobellis NS et al; (2005) analyzed essential oils extracted by hydrodistillation from fruits of Cuminum cyminum L. and Carum carvi L. were by gas chromatography (GC) and GC-mass spectrometry (MS). The main components of C. cyminum oil were p-mentha-1,4-dien-7-al, cumin aldehyde, gamma-terpinene, and beta-pinene, while those of the C. carvi oil were carvone, limonene, germacrene D, and trans-dihydrocarvone. Antibacterial activity, determined with the agar diffusion method, was observed against Gram-positive and Gram-negative bacterial species in this study. The activity was particularly high against the genera Clavibacter, Curtobacterium, Rhodococcus, Erwinia, Xanthomonas, Ralstonia, and
Agrobacterium, which are responsible for plant or cultivated mushroom diseases worldwide. In general, a lower activity was observed against bacteria belonging to the genus Pseudomonas. These results suggested the potential use of the above essential oils for the control of bacterial diseases.

Satyanarayana S et al; (2004)\textsuperscript{155} performed study on antioxidant activity of the aqueous extracts of five umbelliferous fruits--caraway (Carum carvi), coriander (Coriandrum sativum), cumin (\textit{Cuminum cyminum}), dill (Anethum graveolens) and fennel (Foeniculum vulgare) in comparison with the known antioxidant ascorbic acid in \textit{in vitro} studies. The amount of aqueous extract of these five umbelliferous fruits and ascorbic acid needed for 50\% scavenging of superoxide radicals was found to be 105 microg (caraway), 370 microg (coriander), 220 microg (cumin), 190 microg (dill), 205 microg (fennel) and 260 microg (ascorbic acid). The amount needed for 50\% inhibition of lipid peroxide was 2100 microg (caraway), 4500 microg (coriander), 4300 microg (cumin), 3100 microg (dill), 4600 microg (fennel) and 5000 microg (ascorbic acid). The quantity needed for 50\% inhibition of hydroxyl radicals was 1150 microg (caraway), 1250 microg (coriander), 470 microg (cumin), 575 microg (dill), 700 microg (fennel) and 4500 microg (ascorbic acid). The daily use of the above fruits in various forms is very common in India and the present study revealed strong antioxidant activity of their extracts that was superior to known antioxidant ascorbic acid and indicate their intake may be beneficial as food additives.

Gagandeep et al; (2003)\textsuperscript{156} evaluated chemopreventive potentials of different doses of a cumin seed-mixed diet against benzo(a)pyrene [B(a)P]-induced forestomach tumorigenesis and 3-methylcholanthrene (MCA)-induced uterine cervix tumorigenesis. Results showed a significant inhibition of stomach tumor burden (tumors per mouse) by cumin. Tumor burden was 7.33 +/- 2.10 in the B(a)P-treated control group, whereas it reduced to 3.10 +/- 0.57 (P < 0.001) by a 2.5\% dose and 3.11 +/- 0.60 (P <0.001) by a 5\% dose of cumin seeds. Cervical carcinoma incidence, compared with the MCA-treated control group (66.67\%), reduced to 27.27\% (P < 0.05) by a diet of 5\% cumin seeds and to 12.50\% (P < 0.05) by a diet of 7.5\% cumin seeds. The effect of 2.5 and 5\% cumin seed-mixed diets was also
examined on carcinogen/xenobiotic metabolizing phase I and phase II enzymes, antioxidant enzymes, glutathione content, lactate dehydrogenase (LDH), and lipid peroxidation in the liver of Swiss albino mice. Levels of cytochrome P-450 (cyt P-450) and cytochrome b5 (cyt b(5)) were significantly augmented (P < 0.05) by the 2.5% dose of cumin seed diet. The levels of cyt P-450 reductase and cyt b(5) reductase were increased (significance level being from P < 0.05 to P < 0.01) by both doses of cumin. Among the phase II enzymes, glutathione S-transferase specific activity increased (P < 0.005) by the 5% dose, whereas that of DT-diaphorase increased significantly (P < 0.05) by both doses used (2.5 and 5%). In the antioxidant system, significant elevation of the specific activities of superoxide dismutase (P < 0.01) and catalase (P < 0.05) was observed with the 5% dose of cumin. The activities of glutathione peroxidase and glutathione reductase remained unaltered by both doses of cumin. The level of reduced glutathione measured as nonprotein sulfhydryl content was elevated (significance level being from P < 0.05 to P < 0.01) by both doses of cumin. Lipid peroxidation measured as formation of MDA production showed significant inhibition (P < 0.05 to P < 0.01) by both doses of cumin. LDH activity remained unaltered by both doses of cumin. The results strongly suggested the cancer chemopreventive potentials of cumin seed and could be attributed to its ability to modulate carcinogen metabolism.

Dhandapani S, et al; (2002)\textsuperscript{157} studied the role of C. cyminum supplementation on the plasma and tissue lipids in alloxan diabetic rats. Oral administration of 0.25 g kg(-1) body weight of C. cyminum for 6 weeks to diabetic rats resulted in significant reduction in blood glucose and an increase in total haemoglobin and glycosylated haemoglobin. It also prevented a decrease in body weight. C. cyminum treatment also resulted in a significant reduction in plasma and tissue cholesterol, phospholipids, free fatty acids and triglycerides. Histological observations demonstrated significant fatty changes and inflammatory cell infiltrates in diabetic rat pancreas. But supplementation with C. cyminum to diabetic rats significantly reduced the fatty changes and inflammatory cell infiltrates. Moreover, C. cyminum supplementation was found to be more effective than glibenclamide in the treatment of diabetes mellitus.
Vasudevan K et al; (2000) investigated effect of aqueous extracts (10% w/v) of red pepper (Capsicum annuum), fennel (Foeniculum vulgare), omum/ajwan (Carum copticum), cardamom (Elettaria cardamomum), black pepper (Piper nigrum), cumin (Cuminum cyminum) and coriander (Coriandrum sativum) on gastric secretion. The stomach of pentobarbitone-anesthetized rats was perfused at 0.15 mL/min with aqueous extracts of spice or acetylcholine (1 microgram/mL or 10 micrograms/mL solutions, in 40 min blocks, twice in each experiment bracketed by saline perfusions. The acid content in the samples was estimated by titration with 0.1N NaOH with phenolphthalein as indicator. Atropine 1 microgram/mL was added to the perfusion fluid in 28 experiments. In 32, acute gastric mucosal injury was induced by leaving aspirin 125 mg/Kg in the stomach for 2 h before perfusion. All the spices tested increased acid secretion in the following declining order: red pepper, fennel, omum, cardamom, black pepper, cumin, coriander. Red pepper increased acid secretion (mean [SEM] 0.93 [0.16] mL 0.1N HCl) to about 7 times the basal secretion (0.14 [0.05]; p < 0.005). The increase in acid secretion by the other spices was as follows: fennel 0.42 (0.11) mL 0.1 N HCl from basal secretion (0.12 [0.03]) (p < 0.02); omum 0.33 (0.05) from 0.09 (0.02) (p < 0.01); cardamom 0.28 (0.04) from 0.10 (0.03) (p < 0.005); black pepper 0.19 (0.03) from 0.04 (0.01) (p < 0.005); cumin 0.12 (0.02) from 0.08 (0.01) (p < 0.05); coriander 0.18 (0.03) from 0.09 (0.02) (p < 0.005). Atropine abolished the acid secretion induced by acetylcholine and significantly reduced acid induction by red pepper, omum and coriander, but not that by fennel. In experiments with aspirin-induced mucosal injury the basal acid secretion was low; acid secretion by red pepper and fennel was reduced significantly, but not that by acetylcholine. Cumin and coriander increased acid secretion in injured stomachs.

Ahmad M et al; (2000) screened the seeds of Cuminum nigrum phytochemically and were found to contain 8% flavonoids and 0.01% alkaloids. When studied for their effect on blood glucose levels, oral administration of the flavonoid contents of the plant caused a hypoglycaemic effect at a dose range of 0.5 to 1.5 g/kg, both in normal and alloxan-diabetic rabbits. The hypoglycaemic effect started 2 h after drug administration, reaching a maximum within 4-8 h and the blood glucose levels
returned close to normal within 24 h of drug administration. The glibenclamide (5 mg/kg) produced a hypoglycaemic effect in the normal rabbits, whereas it had no effect on the blood glucose levels of alloxan-diabetic rabbits. The alkaloids isolated from C. nigrum seeds, however, failed to exert any significant hypoglycaemic effect in either the normal or diabetic rabbits. A 7 day acute toxicity study in rabbits did not produce any apparent adverse effect at doses as high as 5 g/kg orally. These data indicate that the total flavonoid contents of C. nigrum seeds exhibited considerable hypoglycaemic activity in rabbits and may therefore be responsible for the previously reported antidiabetic activity of the seeds. It was conceived that the C. nigrum flavonoids possess insulin triggering and/or insulin-like properties.

Nalini N et al; (1998)\textsuperscript{160} reported that in the presence of a known colon carcinoma, 1,2-dimethyl hydrazine (DMH), the activity of beta-glucuronidase was found to be significantly increased in the distal colon, distal intestine, liver and colon contents and the activity of mucinase was increased in both the colon and fecal contents when compared to control rats. Chilli (Capsicum annum L., Solanaceae) administration also showed an increase when compared to control rats, whereas supplementation with cumin (Cuminum cyminum L., Apiaceae) and black pepper (Piper nigrum L., Piperaceae) in the presence of DMH showed more or less similar values as that of the control rats. The increase in beta-glucuronidase activity may increase the hydrolysis of glucuronide conjugates, liberating the toxins, while the increase in mucinase activity may enhance the hydrolysis of the protective mucins in the colon. Thus cumin and black pepper may protect the colon by decreasing the activity of beta-glucuronidase and mucinase. Histopathological studies also showed lesser infiltration into the submucosa, fewer papillae and lesser changes in the cytoplasm of the cells in the colon in cumin and black pepper groups when compared to the DMH and chilli treated animals.

Roman-Ramos R et al; (1995)\textsuperscript{161} investigated anti-hyperglycemic effect of 12 edible plants on 27 healthy rabbits, submitted weekly to subcutaneous glucose tolerance tests after gastric administration of water, tolbutamide or a traditional preparation of the plant. Tolbutamide, Cucurbita ficifolia, Phaseolus vulgaris, Opuntia streptacantha, Spinacea oleracea, Cucumis sativus and Cuminum cyminum decrease
significantly the area under the glucose tolerance curve and the hyperglycemic peak. Brassica oleracea var. botrytis, Allium cepa and Allium sativum only decrease the hyperglycemic peak. The glycemic decreases caused by Psidium guajava, Brassica oleracea and Lactuca sativa var. romana were not significant (P > .05). They recommended that the integration of a menu that includes the edible plants with hypoglycemic activity for the control and prevention of diabetes mellitus may be possible and recommendable.

Aruna K and Sivaramakrishnan VM; (1992) investigated the anticarcinogenic properties of some commonly consumed spices and leafy vegetables. The effects of feeding the plant products on the induction of squamous cell carcinomas in the stomach of Swiss mice by feeding benzo[a]pyrene(B[a]P) and on the induction of hepatomas in Wistar rats by feeding 3’-methyl-4-dimethylaminoazobenzene (3’MeDAB) were investigated. Among the nine plant products tested, cumin seeds (Cuminum cyminum Linn) and basil leaves (Ocimum sanctum Linn) significantly decreased the incidence of both B[a]P-induced neoplasia and 3’MeDAB-induced hepatomas. Poppy seeds (Papaver somniferum Linn) significantly inhibited B[a]P-induced neoplasia alone, while the other plant products, asafoetida, kandathipili, turmeric, drumstick leaves, solanum leaves and alternanthera leaves were ineffective. There results suggested that cumin seeds, basil leaves and to a lesser extent poppy seeds, which are all widely used in Indian cooking, may prove to be valuable anticarcinogenic agents.

Sambaiah K and Srinivasan K; (1991) studied the effect of a few common spices--cumin (Cuminum cyminum, cinnamon (Cinnamomum zeylanicum), ginger (Zingiber officinale), mustard (Brassica nigra) and tamarind (Tamarindus indica) added to normal and hypercholesterolemia inducing diet on serum and liver cholesterol levels in rats. These spices did not show any cholesterol lowering effect when included in the diet at about 5-fold the normal human intake level.

Srivastava KC; (1989) reported that extracts from several spices behave as antiaggregatory agents and inhibit eicosanoid synthesis. Similar studies with extracts prepared from cumin (Cuminum cyminum) and turmeric (Curcuma longa) were
undertaken. Ethereal extract of both cumin and turmeric inhibited arachidonate-induced platelet aggregation. Extracts from these spices inhibited thromboxane B2 production from exogenous (14C) arachidonic acid (AA) in washed platelets; a simultaneous increase in the formation of lipoxygenase-derived products was observed. Less TxB2 was produced in blood samples treated with turmeric extract when they were allowed to clot. Turmeric extract inhibited incorporation of (14C)AA into platelet phospholipids and deacylation of AA-labelled phospholipids on stimulation with calcium ionophore A23187. Cumin extract was devoid of such effects. Extracts from the two spices reduced the formation of (14C)TxB2 from AA-labelled platelets when they were challenged with A23187.

Paul S and Kang SC; (2011) investigated the effects of essential oil of Trachyspermum ammi fruits on human sperm viability and membrane integrity. Chemical compositions of the oil were analysed by GC-MS. Thirty compounds representing 91.39% of the total oil were identified. The viability and membrane integrity of human spermatozoa were assessed using minimum effective dose (MED) ml(-1) of the oil. Sperm treated with essential oil concentration (125 oil showed a significant decrease (P<0.05) in viability assessed by eosin-nigrosin and fluorescence dual staining. Moreover, the treated sperm also showed a significant loss (P<0.05) of functional mitochondria and antioxidant enzyme, catalase (EC 1.11.1.6, CAT), when compared to control. The cholesterol:phospholipid ratio was also increased (P<0.05) in treated sperm when compared to control, which is an indicator of loss of binding ability of human spermatozoa to the zona pellucida. The scanning electron microscopic studies demonstrated the loss of membrane integrity in essential oil-treated human spermatozoa, which showed vacuolation, swelling of acrosomal cap, detachment of head portion and tail coiling. Present observations indicated the spermicidal property of essential oil of T. ammi fruits, which could be helpful to develop medicinal preparations as a male contraceptive.

Paul S and Kang SC; (2011) conducted a study to determine the spermicidal and contraceptive efficacy of essential oil of Trachyspermum ammi on human sperm in vitro. Chemical compositions of the oil were analyzed by GC-MS. Nearly 30
compounds representing 91.39% of the total oil were identified. The minimum effective dose (MED) of essential oil of T. ammi that induced instant immobilization of human spermatozoa *in vitro* was 125μg/mL. The motility was also irreversible. All of the human sperms were found to be non viable within 10min at this concentration. The activity of acrosomal enzyme was reduced and a significant releases of 5'-nucleotidase into the surrounding medium was noted after treatment with MED concentration of essential oil, indicating the plasma membrane degradation of the sperm. The maximum number of human sperm failed to decondense when treated with MED concentration of essential oil. The morphological deformities of sperm plasma membrane were evidenced by SEM, which showed vaculation, detachment of heads and tail coiling. The present research indicated that essential oil of T. ammi possesses appreciable spermicidal potential, which may be explored as an effective constituent of vaginal contraceptive.

Khan R *et al*; (2010) investigated different solvent extracts of *Prosopis spicigera* (P. Spicigera), *Zingiber officinale*, and *Trachyspermum ammi* (T. ammi) to determine their efficacy against multidrug resistant microbes. Multidrug resistant (MDR) strains of *Candida albicans*, *Candida krusei*, *Candida tropicalis*, *Candida glabrata*, *Escherichia coli* and reference strains of *Streptococcus mutans* and *Streptococcus bovis* were used in the study. The petroleum ether fraction of T. ammi (least MIC- 625 microg/ml) showed best activity when compared to its other fractions. Qualitative analysis of the phytoconstituents was also performed.

Singh B and Kale RK; (2010) investigated *Trachyspermum ammi* seed for its cancer chemopreventive efficacy. Herein, the chemopreventive effect of different doses (2%, 4%, and 6%) of test diets of *Trachyspermum ammi* seeds were examined on DMBA-induced skin and B(a)P-induced forestomach papillomagenesis, inducibility of drug metabolizing phase I and phase II enzymes, antioxidant enzymes (catalase, superoxide dismutase, glutathione peroxidase, glyoxalase I), reduced glutathione content, and peroxidative damage. Results exhibited a significant reduction in the skin as well as the for stomach tumor multiplicity with respect to all doses of test diet as compared to the control group. Biochemical assays revealed a significant increase in the activities of phase I enzymes especially with
6% test diet. A concomitant increase in the activities of the phase II enzymes and antioxidant enzymes were observed in Trachyspermum ammi treated groups. The content of reduced glutathione was significantly elevated, whereas the peroxidative damage along with lactate dehydrogenase activity exhibited a significant reduction with all the three doses of test diet. These findings were indicative of chemopreventive potential of Trachyspermum ammi seeds against carcinogenesis.

Kaur T et al (2009)\textsuperscript{168} reported successfully purification of an anticalcifying protein from the seeds of Trachyspermum ammi (L.) Sprague ex Turril (Umbelliferae) using oxalate depletion assay and deciphered its inhibitory activity against calcium oxalate crystal growth. The antilithiatic activity of Trachyspermum ammi anticalcifying protein (TAP) was studied in urolithiasis rat model. Urolithiasis was induced by exposure of 0.4% ethylene glycol (EG) and 1.0% ammonium chloride (NH\textsubscript{4}Cl) for 9 days. The efficacy of TAP was studied in another group given same dose of EG and NH\textsubscript{4}Cl in addition to 2mg/kg body weight of TAP. Further, we evaluated ability of TAP to inhibit the attachment of calcium oxalate (CaO(x)) crystal in kidney tissue and studied the consequences of CaO(x) adhesion on renal functioning and tissue integrity. The antilithiatic potential of TAP was confirmed by its ability to maintain renal functioning, reduce renal injury and decrease crystal excretion in urine and retention in renal tissues. They suggested the potential of TAP in preventing calcium oxalate deposition and the basis for the development of antilithiatic drug interventions against urolithiasis.

Kaur GJ, & Arora DS., (2009)\textsuperscript{169} investigated antibacterial activity of aqueous and organic seed extracts Trachyspermum ammi using agar diffusion assay, minimum inhibitory concentration and viable cell count studies; and their antibacterial effect was compared with some standard antibiotics. The presence of major phytocconstituents was detected qualitatively and quantitatively. The isolated phytocconstituents were subjected to disc diffusion assay to ascertain their antibacterial effect. Hot water and acetone seed extracts showed considerably good antibacterial activity against all the bacteria except Klebsiella pneumoniae and one strain of Pseudomonas aeruginosa. Minimum inhibitory concentration for aqueous and acetone seed extracts ranged from 20-80 mg/ml and 5-15 mg/ml respectively.
Viable cell count studies revealed the bactericidal nature of the seed extracts. Statistical analysis proved the better/equal efficacy of some of these seed extracts as compared to standard antibiotics. Phytochemical analysis showed the presence of 2.80 - 4.23% alkaloids, 8.58 - 15.06% flavonoids, 19.71 - 27.77% tannins, 0.55-0.70% saponins and cardiac glycosides.

Kaur T et al; (2009)\(^{170}\) examined the efficacy of Trachyspermum ammi on CaOx crystallization \textit{in vitro} and further by combining conventional biochemical methods with recent advances in mass spectrometry, a novel calcium oxalate (CaOx) crystal growth inhibitor was purified from the seeds of Trachyspermum ammi. An anticalcifying protein from the seeds of Trachyspermum ammi was purified by three step purification scheme; ammonium sulphate fractionation, anion exchange chromatography and molecular sieve chromatography based on its ability to inhibit calcium oxalate crystallization \textit{in vitro}. An anticalcifying protein having molecular weight 107 kDa and isoelectric point 6.2 was isolated. Amino acid analysis of Trachyspermum ammi anticalcifying protein (TAP) showed abundant presence of acidic amino acids (Asp and Glu). Matrix-assisted laser desorption/ionization-time-of-flight mass spectrometry of TAP showed similarities with an unnamed protein product of Vitis vinifera (CAO23876) after matching peptide mass fingerprints in MASCOT search engine. Two EF hand domains were identified in unnamed protein product of Vitis vinifera (CAO23876) by SMART normal module. Due to a significant similarity of TAP with unnamed protein product of Vitis vinifera, presence of two EF hand domains in TAP was anticipated, signifying its calcium binding properties which is a feature of most kidney stone inhibitory proteins.

Lateef M et al; (2006)\(^{171}\) screened One hundred fifty-two methanol and water extracts of different parts of 71 plants commonly used in Sudanese traditional medicine for their inhibitory effects on hepatitis C virus (HCV) protease (PR) using \textit{in vitro} assay methods. Thirty-four extracts showed significant inhibitory activity (\(\geq 60\%\) inhibition at 100 microg/mL). Of these, eight extracts, methanol extracts of Acacia nilotica, Boswellia carterii, Embelia schimperi, Quercus infectoria, Trachyspermum ammi and water extracts of Piper cubeba, Q. infectoria and Syzygium aromaticum, were the most active (\(\geq 90\%\) inhibition at 100 microg/mL).
From the E. schimperi extract, two benzoquinones, embelin (I) and 5-O-methylembelin (II), were isolated and found as potent HCV-PR inhibitors with IC(50) values of 21 and 46 microM, respectively. Inhibitory activities of derivatives against HCV-PR as well as their effects on other serine proteases were also investigated.

Singh VK et al; (1999) reported that in vivo exposure of Lymnaea acuminata to thymol and [6]-gingerol (active molluscicidal components of Trachyspermum ammi and Zingiber officinale, respectively) indicates that they significantly alter acetylcholinesterase, lactic dehydrogenase, succinic dehydrogenase and cyto-oxidase activity in the nervous tissue of snails. In vitro exposure showed that, except for acetylcholinesterase and lactic dehydrogenase, no significant changes were observed in cyto-oxidase and succinic dehydrogenase activity in the nervous tissue of L. acuminata. Sublethal exposure to thymol and [6]-gingerol reduced the levels of 5-hydroxytryptamine (5-HT) and dopamine (DA) in the nervous tissue of L. acuminata. There was, however, no significant change in the level of 5-hydroxy indol acetic acid (5-HIAA). Thymol and [6]-gingerol thus affects all the known neurotransmission mechanisms in the snail either separately or through a complex interaction between the different neurotransmitters. This may account for their toxicity to snails.

Srivastava KC; (1988) found that ethereal extract of Trachyspermum ammi inhibited platelet aggregation induced by arachidonic acid (AA), epinephrine and collagen; in this respect it was most effective against AA-induced aggregation. Inhibition of aggregation by omum could be explained by its effect on platelet thromboxane production as suggested by the following experimental observation. (i) Omum reduced TxB2 formation in intact platelet preparations from added arachidonate, and (ii) it reduced the formation of TxB2 from AA-labelled platelets after stimulation with Ca2+-ionophore A23187 by a direct action on cyclooxygenase as it did not affect the release of AA from labelled platelets. An increased formation of lipoxygenase-derived products from exogenous AA in omum-treated platelets was apparently due to redirection of AA from cyclooxygenase to the lipoxygenase pathway.