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Chemical composition and biological activity of *Coriandrum sativum* L.: A review

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Coriander (*Coriandrum sativum* L.) also called as Cilantro, Arab parsley, Chinese parsley, Kasbour is cultivated for its seeds and foliage for extraction of essential oil using hydrodistillation. The GC-MS compositional analysis of coriander seed essential oil showed the presence of many compounds viz linalool, camphor, geraniol, α–pinene, γ–terpinene, geranyl acetate and limonene. Essential oil of coriander is known to exhibit wide range of biological activities like antibacterial, antifungal, antioxidant, insecticidal and in addition it also exibit pharmacological activities such as anti-inflammatory, anxiolytic, antimicrobial, diuretic, cognition improvement, antidiabetic, antiseptic, antihypertensive, lipolytic, myorelaxant, anticancerous, antimutagenic, and free radical scavenging activities.

Keywords: Biological activities, Chemical composition, *Coriandrum sativum* L., Essential oil, Medicinal value.

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Introduction

Coriander (*Coriandrum sativum* L.) is a glabrous, aromatic, herbaceous annual herb belonging to the family Apiaceae[1]. It is commonly known as *Dhaniya* in Hindi, *Dhanya* in Sanskrit and *Kotthamalli* in Tamil. Coriander is one of the oldest spices mentioned in recorded history, with evidence of its use more than 5000 years ago. Its use was mentioned in Egyptian, Sanskrit and Roman literature. Egyptians called this herb the spice of happiness[2]. The coriander seeds are one of the most important spices in the world and are regularly used in the Indian Kitchen. The herb as young plants is used to prepare curry, soups, salads, and sauces, whereas the fruit is mainly used as a seasoning for pickles, cold meats, confectionery products and seasoning mixtures[3,4]. It is the most widely consumed popular ingredient in the world as a domestic spice, a traditional medicine, and a flavoring agent[5]. Coriander is available throughout the year providing a fragrant flavor that is reminiscent of both citrus peel and sage. Its essential oil is used in pharmaceutical recipes and as a fragrance in cosmetics[6,7].

In addition to culinary value, coriander is known for its wide range of healing properties. It is generally used in gastrointestinal complaints such as anorexia, dyspepsia, flatulence, diarrhea, griping pain and vomiting. Coriander fruit is also reputed as refrigerant, tonic, diuretic, and aphrodisiac, while, its essential oil is considered useful in flatulent colic, rheumatism, neuralgia, etc. Coriander is also used as antiedemic, anti-inflammatory, antiseptic, emmenagogue, antidiabetic, antihypertensive, lipolytic and myorelaxant, and possess nerve-soothing property[8]. Coriander is used to flavour several alcoholic beverages like gin[9]. The German name Schwindelkorner or dizziness grains seems to be connected with the former practice of using coriander fruits to flavour beer, which increased its inebriating effect[10].

Botanical description

Coriander is a slender, soft, hairless, glabrous, branched, annual and a perennial herb growing to 50 cm tall cultivated all over India. The crop matures in 2-3 months after sowing and is pulled out with roots. After drying, fruits are threshed out and dried in sun, winnowed and stored in bags. The seeds have a lemony citrus flavour when crushed, due to the presence of terpenes linalool and pinene. The stem is more or less erect and sympodial, monochasial-branched, sometimes with several sides of branching at the basal node. Each branch finishes with an inflorescence, flowers are pink to white and in small, loose umbels. The stem is hollow, green and sometimes turns red or violet during the flowering

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period. The leaves are of two types: the upper leaves are reduced to a small leaf sheath and the lower leaves are stalked. The leaves are green and their underside often shiny waxy. The fruits are globular and contain two seeds[11]. The plant is cultivated for its leaves and seeds. The days-to-maturity requirement is approximately 100 days. The smaller-seeded coriander requires a longer growing period of approximately 120 days[12]. There are two major sub-varieties of coriander: *C. sativum* L. *vulgare* Alef. and *C. sativum* L. *microcarpum* DC[11]. The classification of coriander[13] is as Kingdom- Plantae; Subkingdom- Trachiobionta; Superdivision- Spermatophyta; Division- Magnoliophyta; Class- Magnoliopsida; Subclass- Rosidae; Order- Apiales; Family- Apiaceae; Genus- *Coriandrum* and Species- *Sativum.*

Geographical distribution

It is native to the Mediterranean and Middle Eastern regions and has been known in Asian countries for thousands of years. It is indigenously distributed in Italy, but widely cultivated in the Netherlands, Central and Eastern Europe (Russia, Hungary and Holland), the Mediterranean (Morocco, Malta, and Egypt), North Africa, China, India and Bangladesh. In India, it is widely cultivated in Andhra Pradesh, Maharashtra, West Bengal, Uttar Pradesh, Rajasthan, Jammu and Kashmir, Madhya Pradesh, Tamil Nadu, Karnataka and Bihar. Nowadays coriander is grown almost everywhere except Japan for the leaves (cilantro), the seeds (coriander) or both[14].

World production and consumption

Coriander essential oil is among the most used essential oils worldwide[15]. It is approved for food use by the FDA, which granted it the GRAS status, by FEMA and the Council of Europe[15]. It is one of the 20 major essential oils in the world market[16] and mainly cultivated for the essential oil from seeds (ranges between 0.3 to 1.1 %)[17]. India is a significant producer of coriander, but almost all the production is used for domestic consumption. India is the biggest producer, consumer and exporter of coriander in the world with an annual production averaging around 3 lakh tonnes. The production fluctuates widely between years and varied from 2 to 4 lakh tonnes in this decade. Major producers of coriander are Morocco, Canada, India, Pakistan, Romania, and the former Soviet Union. Other producers include Iran, Turkey, Egypt, and Israel in the Middle East; China, Burma, and Thailand in Asia; and Poland, Bulgaria, Hungary, France, and the Netherlands in Europe. The United States is the primary export market for Canadian large seeded coriander. Secondary export markets include Sri Lanka, Trinidad and Tobago, the United Kingdom, Mexico and Guatemala. The major importers of coriander from India are Europe, US, Singapore, and the Gulf countries.

Chemical composition

The extraction of essential oil from coriander seeds and leaves was carried out through hydrodistillation[18]. The yield of coriander seed essential oil varied from 0.03–2.6 %, depending on the species, growing region and climatic conditions. The accumulation and chemical composition of essential oil in plants were determined by different factors like environmental[19,20], genetic[21,22], ontogenetic[23,24] as well as cultivation. The fresh coriander herb, containing essential oil[26,27], fatty acids[17], flavonoids[28], carotenoids[29] as well as coumarin compounds[30]. The aroma of the coriander fruit and herb is completely different, the aliphatic aldehydes (mainly C_{10}–C_{16} aldehydes), having unpleasant odour, are the main components of the volatile oil from the fresh herb[25], linalool and other oxidized monoterpenes as well as monoterpene hydrocarbons predominate in the oil distilled from the fruit[30] (Fig. 1). The compounds present in seeds and leaves were found to vary significantly (Table 1).

The composition of coriander seed essential oil was found to vary with place of production (Table 2)[31-43]. The chemical composition of coriander revealed that the linalool was 72.3 and 77.7 %, while α-pinene was 5.9 and 4.4 %, γ-terpinene 4.7 and 5.6 %, camphor 4.6 and 2.4 %, limonene 2.0 and 0.9 %, in Argentinean and European coriander, respectively[44]. The essential oil from New Zealand contained linalool, α-pinene, γ-terpinene, camphor and limonene in the concentration of 65.8, 6.8, 6.1, 5.1, and 2.7 %, respectively[45]. In Russian coriander seed essential oil, linalool constitutes about 68.0 % of oil[46]. Hence we can conclude that linalool was the main compound in the coriander seed essential oil.

Biological properties

Essential oils of herbs and their component products from the secondary metabolism of plants have many applications in ethno-medicine, food flavouring and preservation as well as in the fragrance

and pharmaceutical industries[47]. It is also known to possess various types of biological activities.

Antibacterial activity

The spice, *C. sativum* is one of the plants that are known to produce essential oils with antimicrobial activity[48]. The coriander seed essential oil was screened for antibacterial activity against both Gram positive (*Staphylococcus aureus*, *Bacillus* spp.) and Gram negative (*Escherichia coli*, *Salomonella typhi*, *Klebsiella pneumonia*, *Proteus mirabilis*, *Pseudomonas aeruginosae*) bacteria and a pathogenic fungi *Candida albicans*[40,49]. The essential oil showed pronounced antibacterial activity against all of the microbes tested except for *P. aeruginosae*, *B. cereus* and *Enterococcus faecalis*[50] which showed resistance. *C. sativum* showed a significant antibacterial activity against *E. coli* and *B. megaterium* bacterial species and two mycopathogenic ones responsible for cultivated mushroom diseases as determined with the agar diffusion method whereas *F. vulgare* var. showed a much reduced effect[35].

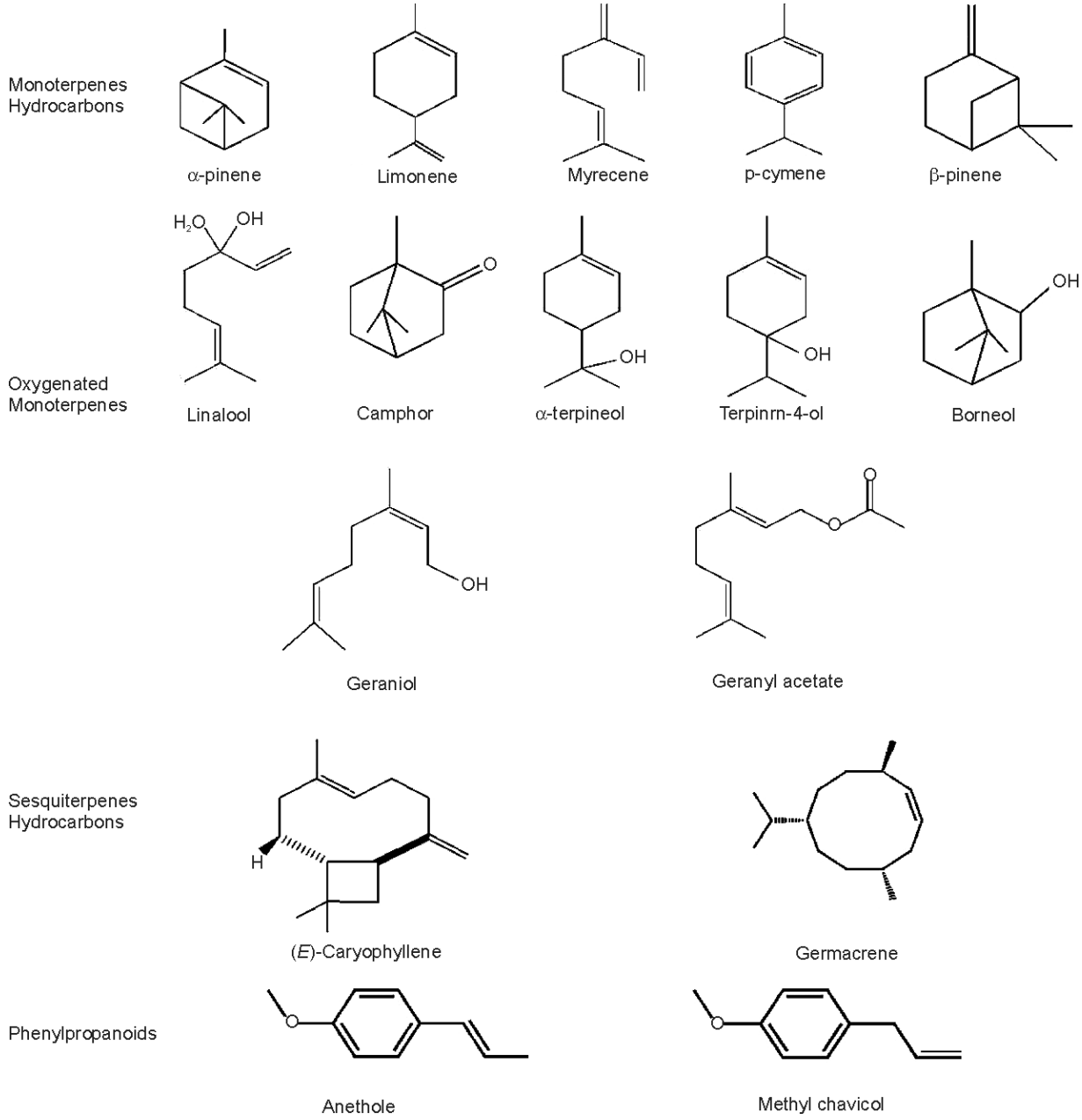

Fig. 1 — The major compounds isolated from the *Coriandrum sativum* L.

Table 1 — Percentage composition variation in seeds and leaves of coriander

Seeds			Leaves		
S. No.	Compounds	Area %	S. no.	Compounds	Area %
1	Linalool	55.49	1	(E)-2-Decanal	32.23
2	γ-terpinene	7.47	2	Linalool	13.97
3	α-pinene	7.14	3	(E)-2-Dodecenal	7.51
4	Camphor	5.59	4	(E)-2-Tetradecenal	6.56
5	Decanal	4.69	5	2-Decen-1-ol	5.45
6	Geranyl acetate	4.24	6	(E)-2-undecenal	4.31
7	Limonene	3.10	7	Dodecanal	4.07
8	Geraniol	2.23	8	(E)-2-Tridecanal	3.00
9	Camphene	1.78	9	(E)-2-Hexadecenal	2.94
10	D-Limonene	1.36	10	Pentadecenal	2.47
11	Myrcene	0.98	11	Undecanal	2.43
12	p-Cymene	0.90	12	1-Decanol	2.18
13	α-terpinol	0.81	13	α-pinene	1.90
14	Decanol	0.81	14	Decanal	1.73

Table 2 — Chemical composition of essential oils of *Coriandrum sativum* L. leaves and fruits from different origins

Region	Plant parts	Major compounds	Percentage (%)	Reference
Tunisia (Northwestern region)	Fruit	Linalool	86.1	20
		γ-Terpinene	2.15	
		α-Pinene	1.65	
		Geraniol	1.63	
Tunisia (Northeastern region)	Fruit	Linalool	87.54	24
		Cis-Dihydrocarvone	2.36	
		Thymol	1.85	
Massachusetts, USAL	Leaf	(E)-2-dodecenal	15.6	25
		(E)-2-tetradecenal	12.7	
		(E)-2-decenal	12.1	
		Decanal	9.25	
		2-decen-1-ol	8.18	
		(E)-2-undecenal	5.32	
		dodecanal	4.96	
		(E)-2-pentadecenal	4.77	
Bangladesh	Fruit	Linalool	37.70	30
		Geranyl acetate	17.6	
		γ- Terpinene	14.4	
		α- Cedrene	3.87	
		Citronellal	1.96	
		Geraniol	1.87	
		β- Pinene	1.82	
		m-Cymene	1.27	
		Citronellol	1.31	

(*Contd*.)

Table 2 — Chemical composition of essential oils of *Coriandrum sativum* L. leaves and fruits from different origins (*Contd*.)

Region	Plant parts	Major compounds	Percentage (%)	Reference
Bangladesh	Leaf	2-Decenoic acid	30.82	30
		E-11-tetradecenoic acid	13.37	
		Capric acid	12.71	
		Tridecanoic acid	5.45	
		E-Undecanoic acid	4.97	
		2-Undecenal	3.87	
		Cyclododecane	2.45	
		Dodecanoic acid	2.63	
Finland	Fruit	Linalool	67.2	31
		Camphor	4.8-4.9	
		Geranyl acetate	3.4-3.6	
		Geraniol	2- 2.4	
		D-limonene	1.9-2.6	
Canada	Fruit	Linalool	25.9	32
		(E)-2-decenal	20.2	
		α-Pinene	2.7	
		Nonane	2.5	
Italy	Fruit	Linalool	64.5	33
		Camphor	6.4	
		p-Cymene	6.3	
		Nerol	4.6	
Fiji	Leaf	E-2-Decen-1-ol	26.00	34
		1-Decanol	19.64	
		E-2-Dodecen-1-ol	4.60	
		Nonane	1.53	
India	Fruit	Linalool	75.30	35
		Geranyl acetate	8.12	
		α-Pinene	4.09	
Iran	Fruit	Linalool	77.92–82.91	36
		α- Thujene	3.98–7.87	
		γ- Terpinene	0.42–7.28	
		p- Cymene	0.84–3.77	
Italy	Fruit	Linalool	65–79	37
		γ-Terpinene	4–7	
		Camphor	3	
		Geranyl acetate	2–4	
		α-Pinene	1–3	
		Geraniol	1–3	
Kenya	Leaf	2E- Decenal	15.9	38
		Decanal	14.3	
		2E- Decen-1-ol	14.2	
		n-Decanol	13.6	
		2E- Dodecenal	6.23	
		Dodecanal	4.36	
		Undecanal	3.23	
		Undecanol	3.37	
		Trans-2-Undecen-1-ol	2.12	
		n- Undecanol	2.38	

(*Contd*.)

Table 2 — Chemical composition of essential oils of *Coriandrum sativum* L. leaves and fruits from different origins (*Contd*.)

Region	Plant parts	Major compounds	Percentage (%)	Reference
Algeria	Fruit	Linalool	73.11	39
		p- Menthe-1,4-dien-7-ol	6.51	
		α-Pinene	3.41	
Brazil	Leaf	1-decenol	24.2	40
		2E-decenol	18.00	
		2Z-dodecenol	17.60	
		Tetradecenol	12.00	
		Decanal	4.8	
		Tridecanal	3.00	
Serbia	Fruit	Linalool	74.6	41
		camphor	1 1.2	
		borneol	5.9	
		p-lymene	4.0	
Pakistan	Fruit	Linalool	69.60	42
		geranyl acetate	4.99	
		γ- Terpinene	4.17	
		p- Cymene	1.12	
		α-Pinene	1.63	
		anethol	1.15	
Romania	Fruit	Linalool	48.4-54.3	43
		γ-terpinene	9.2-12.1	
		α-pinene	5.5-9.3	
		limonene	4.7-6.3	

Antifungal activity

Coriander essential oil is reported to possess antifungal activity[51]. The antifungal activity of essential oils (Caraway seed oil, fennel seed oil and coriander seed oil) of Apiacea family has been studied and the results revealed that both fungal growth and aflatoxin biosynthesis were decreased by tested oils[52]. Coriander essential oil showed fungicidal activity against the *Candida* strains tested with MLC values equal to MIC value and ranging from 0.05-0.4 % v/v. A synergestic effect between coriander oil and amphotericin B was also observed for *C. albicans* strains, while for *C. tropicalis* strains only an additive effect was observed. This study could be useful in designing new formulations for Candidosis treatment[50,53]. The antifungal was also studied against *Microsporum canis* and *Candida* spp. by the agar-well diffusion method and the minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC) were established by the broth microdilution method[54]. The essential oil induced growth inhibition zones of 28±5.42 and 9.25±0.5 for *M. canis* and *Candida spp*., respectively.

The essential oil of *Coriandrum sativum* showed antimicrobial activity against five species of *C. albicans*, except for *C. tropicalis* CBS 94. The fraction containing alcohols such as 3-hexenol, 1-decanol, 2E-decenol and 2Z-dodecenol showed greater antibiotic property[42]. Coriander essential oil at concentration of 0.15 % could inhibit the growth of fungus in the cake during 60 days storage at room temperature. The results indicated that, Coriander seed essential oil at 0.05, 0.10 and 0.15 % inhibited the rate of primary and secondary oxidation products formation in cake and their effects were almost equal to Butylated hydroxyanisole (BHA) at 0.02 % ($P < 0.01$). The results showed that this essential oil could be used as natural antioxidant and antifungal in food stuffs especially those containing lipid[55]. Coriander oil was found to be most effective due to high content of linalool, geranyl acetate, γ-terpinene, estragole, carvone, limonene which was responsible for high antifungal activity at all concentrations studied.

Antioxidant activity

Addition of coriander to food increased the antioxidant content of food due to the presence of antioxidant and anti-inflammatory compounds[11]. It was a potent natural antioxidant and inhibited unwanted oxidation processes. The coriander leaves

showed stronger antioxidant activity than the seeds[56]. It was reported that the aqueous extracts of seeds exhibited antioxidant activity both *in vitro* and *in vivo*[57]. Time and dose dependent *in vivo* antioxidant activity of fresh coriander juice was evaluated by various methods[58,59]. This spice reduced lipid peroxidation by 300-600 %, increased the antioxidant enzyme activities (catalase by 57-75 %, superoxide dismutase by 57-62 %, and glutathione peroxidase by 80-83 %) and reduced liver damage[2]. Naveen and Farhath[60] observed that coriander seed extract minimized the drug induced oxidative stress and protected the system against its toxicity. The antioxidant property of coriander seed was related to the large amounts of tocopherols, carotenoids and phospholipids, which acted through different mechanisms[61].

Coriander oil could be used as free radical scavenger, preventing oxidative deterioration in foods. It showed greater activity against the radical generating activity of 1,1-diphenyl-2-picrylhydrazyl in several essential oils[62]. The carotenoids extracts of coriander showed a high antioxidant activity with IC_{50} value of 14.29±1.68 µg/mL, scavenging hydroxyl radicals and reducing higher protection to DNA than by the standard gallic acid (IC_{50} value of 357.21±4.29 µg/mL)[63]. Antioxidant effects of this essential oil may be due to its terpene and terpenoid components.

The coriander seeds also showed scavenging activity against superoxides and hydroxyl radicals in a concentration-dependent manner. Maximum free radical-scavenging action and free radical reducing power of coriander seed extract was observed at a concentration of 50 µg GAE (gallic acid equivalent). Increased dietary intake of coriander seeds decreased the oxidative burden in *Diabetes mellitus*[64]. A comparative study of lipophilic and hydrophilic antioxidants was undertaken *in vivo* and *in vitro* grown *C. sativum* by radical scavenging reducing power and lipid peroxidation inhibition[65]. The *in vivo* sample showed the highest antioxidant activity mainly due to its highest levels of hydrophilic compounds.

Insecticidal activity

Essential oils isolated from coriander, were screened for contact and fumigant activities against rice weevil, *Sitophilus oryzae* L., adzuki bean weevil, *Callosobruchus chinensis* L. and rice moth *Corcyra cephalonica* in laboratory assays. Responses varied with test material, insect species, and exposure time. In fumigation assay, coriander at 130 µg/cm^2 caused complete toxicity to all the species within 24 hrs of treatment. In contact assay, the test oil was effective against adults of *S. oryzae*, *C. chinensis* and *C. cephalonica* producing about 90 % toxicity only after 72 hrs of treatment. Against *C. chinensis* adults, test material revealed potent insecticidal activities than other two insects in both fumigation and contact assays even at lower concentrations. These studies showed the strong insecticidal activity of coriander oil and its potential role as a fumigant for *S. oryzae*, *C. chinensis* and *C. cephalonica*[66].

The toxicity of coriander essential oil and its hexane and methanol extracts were studied[67]. Hexane extract (LC-4) was partitioned with ethyl acetate (LC-0). The methanol extract was serially partitioned with hexane (LC-3), ethyl acetate (LC-2), chloroform (LC-1) and butanol (LC-5). Toxicity of these extracts was tested against young and matured eggs of stored product pest *Trogoderma granarium* in laboratory conditions for its insecticidal activity. Results showed that lowest LC_{50} for freshly laid eggs was recorded with LC-4 extract (0.032 %) and highest LC_{50} for early eggs were 2.04 % against extract LC-5. The order of toxicity of different extracts in ascending order against early egg was LC-5 > LC-2 > LC-1 > LC-3 > LC-4 having LC_{50} values 2.044, 1.055, 0.324, 0.186 and 0.032 %, respectively. As for as the toxicity against matured egg was concerned the LC_{50} of all the extracts are significantly similar as the values were in the same fiducial limit and it ranged from 0.515 to 0.647 %. Thus based on two stages of egg LC-4 extract appeared to be best. Results showed that larval stage was not as susceptible as egg stage of *T. granarium* against various extract of *C. sativum.* LC_{50} values of most of the stages against different extracts could not be calculated because at maximum concentration of 2 %, less than 50 % mortality was observed. Therefore LC-1 and LC-5 extracts against early larvae; lethal concentrations could not be calculated. Except for LC-3 extract none of the extract gave sufficient mortality to calculate LC_{50} values. Similarly, for LC-1, LC-2 and LC-4 extract lethal concentrations against late larval stage could not be calculated. Extracts LC-1, LC-2 and LC-4 showed LC_{50} values 0.310, 1.679 and 0.726 %, respectively. The extract LC-3 was found to be effective against all the three ages of larvae life. Although middle aged larvae were not as susceptible as early and late larvae but LC_{50} values early, mid, late were 0.310, 1.748 and 0.418 % respectively for LC-3 extract.

The larvicidal efficacy of the crude seed extracts of *C. sativum* with five different solvents like acetone, ethyl acetate, methanol, ethanol and chloroform was tested against the mosquito larvae filariasis vector *Culex quinquefasciatus*[68]. The mortality was observed after 24 hrs under laboratory conditions. Among the tested solvents, the maximum efficacy was observed in the acetone and methanol extracts. The LC_{50} and LC_{90} values of *C.sativum* were found to be 14.994 and 66.97, respectively. The Chi-square values were significant at 5 % level. From the investigations it was concluded that the crude extract of *C. sativum* showed an excellent potential for controlling the larval instars of *C. quinquefasciatus*.

Pharmacological activites

Pharmacological studies demonstrated hypoglycemic[69], hypolipidemic[70] and antihypertensive[8] effect. Coriander seeds were incorporated into diet and the effect of the administration of coriander seeds on the metabolism of lipids, fed with high fat diet and the effect of the administration of coriander seeds on the metabolism of lipids was studied in rats, fed with high fat diet and added cholesterol. The antihyperglycemic effect of coriander in streptozotocin-diabetic mice had also been reported[71]. The effect of coriander pre-treatment on gastric mucosal injuries caused by sodium chloride, sodium hydroxide, ethanol, indomethacin and pylorus ligation accumulated gastric acid secretions was investigated in rats. The protective effect against ethanol-induced damage of the gastric tissue might be related to the free-radical scavenging property of different antioxidant constituents (linanool, flavonoids, coumarins, catechins, terpenes and polyphenolic compounds) present in coriander. The inhibition of ulcers might be due to the formation of a protective layer of either one or more than one of these compounds by hydrophobic interactions[6]. The essential oil and various extracts from coriander showed anti-inflammatory[8,72] anxiolytic[73], antimicrobial[74,75], diuretic[8,76], cognition improvement[77], antidiabetic, antiseptic, antihypertensive, lipolytic, myorelaxant[8], antibacterial, anticancerous, antimutagenic, antioxidant and free radical scavenging activities[41,78].

Medicinal value

Coriander has been used in medicine for thousands of years[79]. General references to the medical uses of coriander are found in classical Greek and Latin literature[80]. Fresh and deep green coriander and coriander seeds provide many important indigenous health benefits. Coriander promotes bowel movements and acts as a mild laxative. It is effective in treating digestive disorders such as indigestion, nausea, dysentery, diarrhoea, hepatitis and ulcerative colitis. Juice of fresh coriander leaves applied to the forehead cures headache, also it is a good remedy in the treatment of conjunctivitis, diseases of the respiratory and urinary systems, relief anxiety and insomnia, in allergies, amoebic dysentery, burns, cough, cystitis, dizziness, edema, hay fever, headache, hemorrhoids, rash, urethritis, urinary tract infection, urticaria, and vomiting[81-83], diabetes, dyslipidemia[84], indigestion, flatulence, insomnia, renal disorders, loss of appetite and as a diuretic[76].

Coriander fruit is also reputed as refrigerant, tonic, diuretic and aphrodisiac, while, the essential oil is considered useful in flatulent colic, rheumatism, neuralgia, etc. Coriander is also useful in treatment of skin disorders like eczema, pimples, black heads, dry skin and skin ulcers. The crude aqueous extract of coriander seeds increased diuresis, excretion of electrolytes, and glomerular filtration rate in a dose-dependent way; furosemide was more potent as a diuretic and saluretic. The mechanism of action of the plant extract appears to be similar to that of furosemide[85].

A decoction of coriander seeds taken with sugar checks excessive bleeding during menstrual flow. Coriander leaves are thought to have antispasmodic properties and are used for dyspeptic complaints, loss of appetite, and upper abdominal discomforts[86]. The decoction of coriander leaves and seeds are given during fever to alleviate fever[2]. Coriander is also useful in cough and dyspnoea. Coriander, boiled with milk, affects the central nervous system, and after cures vertigo, syncope and memory loss. Seeds are bitter, aromatic, thermogenic, anti-inflammatory, stimulant and expectorant. Another important health benefit of coriander is that it is good for eyes as it reduces irritation and burning sensation[2]. Antioxidants in coriander prevent eye diseases and problems.

The foliage of coriander is a very good source of phytochemicals such as vitamin C (160 mg/100 g FW), vitamin A (β-carotene 12 mg/100 g FW)[87] and Vitamin B_{12} (60 mg/100 g)[88], polyphenols, and essential oils. Thus, coriander juice is extremely beneficial in deficiencies of vitamin A, B, B_2, and C. It is good for diabetic patients. It stimulates insulin secretion and lowers the blood sugar levels. Vitamin K in coriander is good for the treatment of Alzheimer's

disease. Its antiseptic properties help to cure mouth ulcers. Natural compounds in coriander leaves remove toxic heavy metals from the body without any side effects. In addition, coriander provides health benefits to the persons who are suffering from anaemia as it contains high amounts of iron.

Conclusion

Essential oils are rich in monoterpenes, which meet the non-toxicity and low cost criteria required for new pesticide candidates. Coriander seed essential oil exhibits a wide range of biological activities i.e. antifungal, antibacterial, antioxidant etc., thus represent a good source of potential disease-control agents. Hence it can be concluded that coriander seed essential oil and its bioactive components can be evaluated to replace synthetic compounds in pesticide, food and drug industries.

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