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Chapter 6

POLYPHENOLIC COMPOUNDS OF CORIANDER PLANT FOR HUMAN HEALTH AND DISEASES

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ABSTRACT

Coriander (*Coriandrum sativum L.*) is an annual, culinary, aromatic and medicinal plant. The leaves and seeds of this plant are used in food, pharmaceutical and cosmetic industries. The medicinal properties of the seeds are mainly digestion, rheumatism, joint pains and against worms. It has an array of pharmacological effects such as anticancer, anti-hyperglycemic, antifertility, anti-inflammatory, anxiolytic, antispasmodic, antihyperlipidemic, digestive stimulant and hypotensive. Its fruits are considered to be antibilious, diuretic, carminative, refrigerant, stomachic and aphrodisiac. The plant contains a variety of secondary metabolites including polyphenols such as dimethoxycinnamoylhexoside, quercetin-3-O-rutinoside, quercetin 3-O-glucuronide, kaempferol-3-O-rutinoside and quercetin-3-O-glucoside. Many important flavonol derivatives like 3-O-caffeoylquinic acid, caffeoylquinic acid, ferulic acid glucoside and p-coumaroylquinic acid have also been reported from this plant. This chapter reports a comprehensive knowledge of the coriander plant including the traditional uses, pharmacology and chemistry.

Keywords: antifertility, anticancer, kaempferol, proanthocyanidins, quercetin

INTRODUCTION

Traditional herbal medicine has been adopted as a main course of treatment since time immemorial and still acceptable throughout the world. Due to its unique applications, the researchers have paid attention to work on this area of medical sciences to discover new bioactives. Consequently, abundant studies have been regulated on a number of medicinally important plants and have been paying attention to the bioactive compounds and their biological activities (Properzi et al., 2012).

An illustration of an important medicinal plant coriander (*Coriandrum sativum*), belongs to the family Apiaceae, showed that it is an annual herb and a native of the Eastern Mediterranean region. The plant is now extensively cultivated in several other parts of the world including Russia, Asian countries and Central Europe (Sahib et al., 2013). It is an extensively disseminated and mainly cultivated for its seeds which are the popular spice

of the kitchen. It is reported to have numerous traditional uses and displays various pharmacological effects like diarrhoea, vomiting, cough, fever, dysentery and assorted inflammatory conditions as confirmed by various studies (Sahib et al., 2013).

Coriander green fresh leaf is commonly recognized as Dhania, Kothamalli, Chinese aromatic plant or Cilantro. It is extensively featured in cuisines of different countries including India, Mexico and China. Due to the presence of essential oil (EO), coriander leaves acquire a distinctive aroma and also used as a food flavouring agent (Gil et al., 2002). The leaves of the plant are essentially used as a source for the EO. The dried seeds are added in dishes, fresh leaves used in South India to prepare rasam as a pungent spice, and it's considered as a very good agent for digestion. The leaves are also a significant component in the Thai and Vietnamese cuisine (Gil et al., 2002). In India, the dry seeds are the most important ingredient of the curry powder. In addition, seeds are used for flavouring of numerous foods like fish, meat, bakery and also confectionery product (Gil et al., 2002).

TRADITIONAL MEDICINAL USES

It has been extensively used as cooking constituent and a traditional remedy for diverse disorders. All parts of this herb are edible, extremely dissimilar in use and flavour (Bhat et al., 2014). The coriander root has a different flavour than that of the leaf and frequently used in Asian cuisines, while the chopped stems are used in the form of soups and stews (Verma et al., 2011). Owing to the pungent flavour and health benefits, it has confirmed its worth as an imperative medicinal and aromatic plant as reported by different herbologists. It’s traditionally used for smallpox, gastric complaints, anaemia, nausea, fever, cold, measles and hernias. Seeds are used treating frequent digestion complaints; nausea, dyspepsia, and also dysentery. Leaves are useful in improving digestion. The leaves contain minerals like Fe, Mg and Mn, and also rich in vitamins A, B, and C. It’s a good source of dietary fibre. In Indian traditional medicine, it's used in

different types of disorders like urinary and respiratory problems. In addition, coriander is used as a diuretic, diaphoretic and carminative agent. In Turkey, the seeds are used as a digestive, appetizer and carminative agent (Ugulu et al., 2009).

According to Ayurveda, the regular use of seeds decoction is useful for lowering the hyperlipidemia, cholesterol and triglycerides levels in the blood (Lal et al., 2004). It is also used for joint pains and inflammation. Based on the traditional knowledge, use of Maharasnadhi Quather, an absolute conventional polyherbal formulation contains coriander seeds as a major component, is suggested to be an effective Ayurvedic remedy for joint pains in arthritic conditions (Thabrew et al., 2003).

SECONDARY METABOLITES IN SEEDS

The seeds of the coriander plant contain different bioactive compounds like fatty acids, tocols, sterols, and essential volatile compound.

Lipids

The seeds containing the highest amount of fatty acids are petroselinic (80%), linoleic (16%), oleic (7%), palmitic (4%) and stearic acid (3%) whereas the minor fatty acids are almitoleic, α-linolenic, arachidic, gadoleic, erucic and docosahexenoic acid (Msaada et al., 2009). The neutral lipids in seed oil have been characterised largely as triacylglycerols (95%) followed by free fatty acids (2%), diacylglycerols (1%) and diacylglycerols (0.5%) (Sriti et al., 2010). The study by Sriti et al. (2010) also suggested that the polar lipids present in the seeds are phospholipid (36%), phosphatidyl ethanolamine (34%), phosphatidylinositol (15%), phosphatidic acid and phosphatidylglycerol as the least. Moreover, digalactosyldiacylglycerol (62%) and monogalactosyldiacylglycerol (37%) were also reported from the seeds.

Sterols and Tocols

The coriander seed oil represents imperative resources for sterols. It contains stigmasterol (21.7–29.8%) and β-sitosterol (24.8–36.8%) as major contents. In addition, γ-tocopherol, δ-tocopherol and α-tocopherol were also reported from the oil (Sriti et al., 2010).

Essential oil Compounds

Essential oil (EO) extraction of coriander seeds is mainly performed through hydrodistillation or steam distillation process. EO yield of Indian coriander was recorded ranging from 0.18% to 0.39%. Whereas, Tunisian coriander was found to 0.35% (Msaada et al., 2007). It majorly contains linalool (up to 88%) followed by nerol, borneol, geraniol, α-terpinene, myrcene, α-pinene, linalool acetate and β-pinene (Abou El-Nasr et al., 2013). The major components reported from the EO of the fresh coriander leaves were trans 2-dodecenal, 2-methylenecyclopentanol, decanal, dodecanal, 2-tridecenoic acid, cyclooctane and 2-octenal (Arjun et al., 2017) (Figure 1).

Polyphenols

Msaada et al. (2014) reported that Syrian coriander contains maximum total phenolic content (1.09 mg GAE/g, DW) followed by Tunisian (1.00 mg) and Egyptian coriander (0.94 mg). An ethyl acetate seeds extract of Norwegian coriander was found to contain 1.89 GAE/100g total phenolic content (Wangensteen et al., 2004). The flavonoid and condensed tannins estimated in the methanolic seeds extract ranged from 2.03 to 2.51 mg CE/g DW. In the phenolic fraction, the major phenolic acids found were gallic, vanillic, chlorogenic, caffeic, p-coumaric, ferulic, rosmarinic, trans-hydroxycinnamic, O-coumaric, salicylic and trans-cinnamic acids.

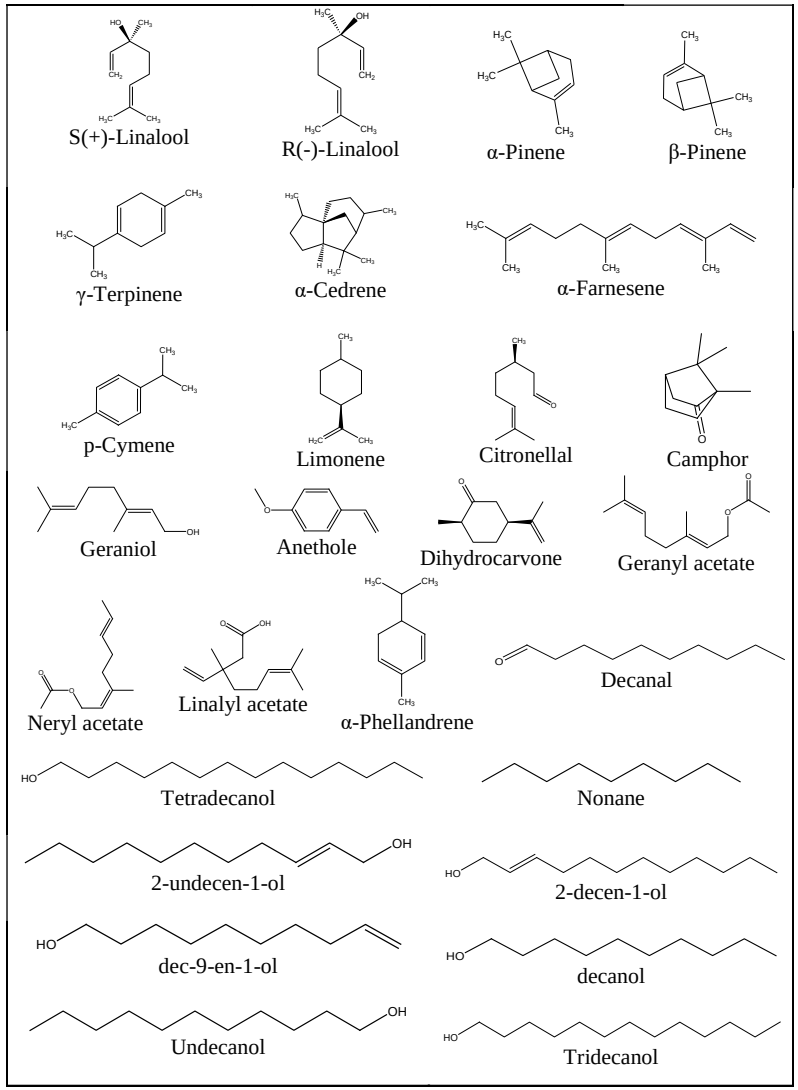

Figure 1. EO compounds present in *Corianderum sativum.*

Moreover, the major flavonoids were quercetin-3-rhamnoside, quercetin dihydrate, luteolin, rutintrihydrate, kaempferol, resorcinol, apigenin, naringin, coumarin and flavone (Msaada et al., 2014). Coriander leaves are mainly containing volatile oil together with phenolic compounds including phenolic acids, flavonoids and polyphenols (Matasyoh et al., 2009).

SECONDARY METABOLITES IN LEAVES

Coriander leaves are mainly containing volatile oil together with phenolic compounds including phenolic acids, flavonoids and polyphenols (Matasyoh et al., 2009).

Lipids

Total fatty acid contents in the basal and upper side of leaves were estimated and found that basal side contains 61.21 mg/g DW whereas upper side contains 41.8 mg/g DW (Neffati and Marzouk, 2008). It contains a predominance of polyunsaturated fatty acids like α-linolenic, heptadecenoic, linoleic, and palmitic acids whereas stearic, stearidonic, oleic, cis- and trans-palmitoleic acids were found in trace amount. The ether extract of the leaves showed the presence of β-cryptoxanthin epoxide, lutein-5,6-epoxide, β-carotene, neoxanthin and violaxanthin. It was also found a good source of β-carotene (Divya et al., 2012).

Polyphenols

Polyphenolic acids in coriander leaf include dimethoxy-cinnamoyl-hexoside, quercetin-3-O-rutinoside, kaempferol-3-O-rutinoside, quercetin 3-O-glucuronide, quercetin-3-O-glucoside. Four flavonol derivatives include 3-O-caffeoylquinic, caffeoylquinic acids, ferulic acid glucoside, and *p*-coumaroylquinic acids. In coriander, vegetative parts derivatives of quercetin were chief bioactive compounds originated. In aerial parts, 21 phenolic compounds are identified. Among those, the main are coumarins, flavonoids, and phenolcarboxylic acids. Other compounds include luteolin, apigenin, hyperoside, vicenin, hesperidin, diosmin, dihydroquercetin, catechin, orientine, chrysoeriol, gallic, salicylic, ferulic acid, dicoumarin, 4-hydroxycoumarin, esculin, esculetin, tartaric acid, maleic acid and arbutin identified (Oganesyan et al., 2007).

The fresh coriander leaves obtained from India contains 24.02 mg GAE/g total phenol contents (Arjun et al., 2017). The major polyphenolic acids identified in leaves of Indian coriander are *p*-coumaric, vanillic, cis- and trans-ferulic acids. In addition, flavonoids in a leaf comprise kaempferol, quercetin, 3′-OMe quercetin, acacetin and also 4′-OMe quercetin. Glycoflavones has not been detected. Therefore, Indian coriander leaf has a high-quality source of quercetin (Nambiar et al., 2010). Melo et al. (2005) reported that the phenolic acids in the coriander leaves from Brazil have protocatechinic acid (6.43 μg/mL), caffeic acid (4.34 μg/mL), and glycitin (3.27 μg/mL). It contains microelements, particularly Zn, and anthocyanins which improves biosynthesis through salicylic acid. In dissimilarity, N appreciably decreased anthocyanin pleased to it is in lowly velocity. Also, P and K, a negative consequence of anthocyanin contented and decreased (Rahimi et al., 2013). The in vitro culture used to investigate novel industrial, medicinal and pharmaceutical potentialities, such as secondary metabolites production are flavones, flavonols and anthocyanins (Rahimi et al., 2013).

Essential Oil Compounds

The seeds of the plant yields comparatively higher essential oil than that of leaves and roots. Among the 44 chemical components of leaf EO, mostly are aromatic acid in which 2-decenoic (30.8%), E-11-tetradecenoic (13.4%), capric acids (12.7%) are the major ones (Bhuiyan et al., 2009). Kenyan coriander leaf contains aldehydes and alcohol as 56.1% and 46.3%, respectively. The major constituents of this oil included (E)-2-decenal (15.9%), decanal (14.3%), (E)-2-decen-1-ol (14.2%) and n-decanol (13.6%), while supplementary compounds included (E)-2-tridecen-1-al, undecanol, (E)-2-dodecenal, dodecanal and undecanal (Matasyoh et al., 2009). The main compounds in Brazilian coriander were reported to 1-decanol (24.20%), (E)-2-decenol (18.00%), and (Z)-2-dodecenol (17.60%) together with aldehydes (Begnami et al., 2010). On the other hand, the main volatile components of Indian coriander leaf were recorded to (E)-2-decenal (18%),

decanal (14%), dec-9-en-1-ol (11%), (E)-2-dodecenal (8%), n-tetradecanol (6%), dodecanal (5%) and decanol (5%). The Korean coriander leaves revealed 39 components represented by 99.62% of the total oil. Its major components were found as cyclododecanol (23%), tetradecanal (17%), 2-dodecenal (9%), 1-decanol (7%), 13-tetradecenal (6%), 1-dodecanol (6%), dodecanal (5%), 1-undecanol (2%), and decanal (2%) (Padalia et al., 2011).

BIOLOGICAL ACTIVITIES

The coriander secondary metabolites in extracts and EO showed different biological activities such as antioxidant, antimicrobial, antihypertensive, antimutagenic, antidiabetic and diuretic (Matasyoh et al., 2009). Volatile components in EO from both leaves and seeds reported to inhibit the growth of different microorganisms. Apart from the medicinal and pharmacological properties, coriander also reported having adverse effects such as convulsion, appetite suppression, anxiety, insomnia and dyspeptic complaints (Eidi et al., 2009). Earlier phytochemical analysis on different parts revealed largely EO (Emamghoreishi et al., 2005) together with terpenoid glycosides, polyphenols, coumarins, and fatty acids (Arjun et al., 2017).

Analgesic Activity

The aqueous extract of coriander seeds inhibited the central pain receptors revealing its analgesic activity (Pathan et al., 2011). Major compounds in coriander namely linalool and monoterpene alcohol play an important role like analgesic activity. Experiments on mice suggest that the glutamatergic arrangement in antinociception was contributed by linalool in antinociception elicited through linalool (Batista et al., 2008). β-cyclodextrin complexes in linalool confirm the production of antinociceptive consequence greater to linalool in (Quintans et al., 2013).

Antimicrobial Activity

Coriander EO shows a broad spectrum inhibition of antibacterial and antifungal agent. Antibacterial activity of seed extract was seen alongside gram-positive and gram-negative bacteria like *Staphylococcus aureus* (PTCC1431), *Pseudomonas aeruginosa* and *Klebsiella pneumonia*. "Plantaricin CS", a narrative antimicrobial peptide having a broad range of antibacterial action was inaccessible from leaf extract against on *S. aureus* (MIC = 1.3 mg/mL). The germicidal property was also seen against *K. pneumoniae* and *P. aeruginosa* with MIC = 2.65 mg/mL and 3.2 mg/mL respectively. The polysaccharides in the cell walls of bacteria prevents active compounds accomplishment to the cytoplasmic membrane, therefore, less antimicrobial activity of Plantaricin CS was seen against gram-negative bacteria Action moderately similar to the activity of antibiotics such as ofloxacin, gentamicin sulfate, tobramycin and beneath analogous conditions ciprofloxacin screened, leaf EO exhibited outstanding activity alongside gram-positive and gram-negative bacteria (Zare-Shehneh et al., 2014). Antibacterial activity potential of EO alongside gram-positive and gram-negative bacteria is based on its membrane permeability. The leaf EO, chiefly owing to the extended chain of C (C6–C10) alcohols and aldehydes, is efficient against *Listeria monocytogenes* (Joji Reddy et al., 2012).

The essential oil of leaves showed antifungal activity against *Fusarium oxysporum*, *Curvularia pallescens*, *F. moniliforme*, *Aspergillus niger*, *A. terreus*, and *F. graminearum*. Plantaricin CS antifungal activity against *Penicillium lilacinum* and *A. niger* with MIC values of 2.5 mg/mL and 2.3 mg/mL, respectively (Zare-Shehneh et al., 2014). Linalool inhibited the growth of *Candida* and *Trichophyton* with MIC ranging from 0.03 to 2 mg/mL. Synergistic effect was observed in the combination of linalool and ketoconazole (FICs = 0.06 - 0.53 mg/mL). EO prevents infection by Candida yeast infection (Furletti et al., 2011).

Anxiolytic Activity

The seed extract showed anxiolytic and relaxant effects. Additional chemical and pharmacological investigations are mandatory to clarify the accurate mechanistic approach of seed extracts and isolate its energetic principles. The anxiolytic commotion seems feasible to be connected with its EO content and flavonoids (Mahendra and Bisht, 2011).

Anthelmintic Activity

In vivo and *in vitro* assessment showed the anthelmintic activity of coriander seed extract against a nematode parasite *Haemonchus contortus*. The hydro-alcoholic extract showed improved in vitro action by touching mature parasites as compared to aqueous solitary (Eguale et al., 2007).

Hypoglycemic and Hypolipidemic Activities

Efficacy of coriander extracts against diabetes has been verified in previous studies (Waheed et al., 2006). The hypoglycemic activity of EO may attribute synergistic accomplishment of geranyl acetate, linalool and γ-terpinene (Abou El-Soud et al., 2012). Anti-hyperglycemic mechanisms of coriander are associated through insulin secretion stimulus and glucose uptake enhancement. Coriander is considered as an impending foundation of functional nutritional supplements for humanizing, controlling blood glucose and preventing the symptoms of chronic complications in type II diabetes mellitus (Pandeya et al., 2013). Tahraoui et al. (2007) reported that the seeds and leaves are used as an antidiabetic representing the mechanism for controlling hyperglycemia. The hypoglycemic effect of coriander leaves was reported through 20 diabetes-induced rats. Out of the 4 groups of rats, three groups were supplemented with concerning 15 g (60 g/kg BW/d) leaves for 15 days. The fourth diabetic untreated group (positive control) and a non-diabetic group (negative control) had a conventional standard cut

down. The experimental results showed that the leaf consumption did not produce a significant hypoglycemic effect in diabetic rats (Jelodar et al., 2007).

Coriander seeds have hypolipidemic activity through a diverse aspect of lipid metabolism in the experimental animals. It degrades bile acids and unbiased sterols, thus lowering cholesterol in tissues and serum (Dhanapakiam et al., 2008). Bioactive compounds present in the seeds are the cause of the hypolipidemic activity in the seeds. Fatty acids like linoleic, palmitic, oleic, stearic and ascorbic acid reduce not only the cholesterol level in blood but also the cholesterol deposition in the internal walls of veins and arteries (Ertas et al., 2005). Coriander is a potential popularized household herbal medicine having defensive and healing consequence alongside hyperlipidemia (Lal et al., 2004).

EO of coriander seeds plays a significant function in stored grain fortification and decreases risks allied with the use of the synthetic insecticide. It develops Canister into an attractive to conserve chemical control strategy (Khani and Rahdari et al., 2012). Insecticidal movement with rice pests (*Rhyzopertha dominica*, *Cryptolestes pusillus* and *Sitophilus oryzae*) were tested in lab condition for their unpredictable toxicity. Linalool is the chief energetic component of EO containing 1617 ppm alongside three pests. Affluent fractions of camphor over 400 ppm were exceptionally toxic to *C. pusillus* and *R. dominica* (López et al., 2008). The seed oil has remarkable toxic effects alongside the *Aedesaegypti larvae* LC_{50}; 21.5 ppm and significantly might function as immunotoxicity alongside the insects (Chung et al., 2012). The seed extract and EO of coriander acquire a tranquillizer hypnotic activity. The main energetic components of coriander in water extract are accountable for a hypnotic consequence (Emamghoreishi and Heidari-Hamedani, 2006).

Antioxidant Activity

Antioxidants refer to a collection of compounds that are able to a setback or inhibit the lipids oxidation, biomolecules and consequently stop or repair

the smashed up human body cells (Shahidi and Naczk, 2004; Tachakittirungrod et al., 2007).

According to free radical scavenging biology and medical science, the reactive oxygen species (ROS) are contributory agents for numerous physical conditions. Standard ingestion of antioxidants can treat such physical condition issues and decrease ROS production in the human body (Tachibana et al., 2001; Arjun et al., 2017). In recent years, consumers are concerned about the addition of synthetic additives to the food, antioxidants, butylated hydroxyl anisole (BHA) and butylated hydroxyl toluene (BHT) that induces DNA damage. Interestingly, medicinal plants hold abundant bioactive compounds having a potential anti-oxidative activity that reduces oxidative stress-induced wounds (Arjun et al., 2017). Herb and spices; have several phytochemicals and are a resource of natural antioxidants such as flavonoids, phenolic compounds, phenolic diterpenes, tannins, alkaloids and phenolic acids. The expected antioxidants are recognized to guard cells against oxidative stress-induced injury, which is normally well-thought-out to be a reason for ageing, cancer and degenerative diseases (Ringman et al., 2005). These physical conditions promote possessions of antioxidants from the plants and spices along with their defensive effect that counteracts with the ROS. Coriander shoot fraction contains caffeic acid; a phenolic correlated to the derivatives of hydroxyl cinnamic acids groups. It is the most important component with the antioxidant activity (Godow et al., 1997). Quinic acid is measured as a phenolic precursor of numerous aromatic compounds in the metabolism of vegetables. This consequence, according to Zhang et al. (2001), was less than that of chlorogenic acid, rutin and quercetin, however analogous to caffeic acid (Masella et al., 1999) and (Harborne, 1973). Ortho dihydroxy benzene arrangements facilitate the contribution of H and continuation of an unsaturated aliphatic sequence located on the aromatic ring, which increases its constancy of the phenoxy free radical all the way through reverberation (Lu and Foo, 2001). Protocatechinic acid inhibited the human low-density lipoprotein (LDL) catalyzed through copper (Zhang, et al., 2001). Xanthophylls are β-cryptoxanthin epoxide, lutein 5, 6-epoxide, violaxanthin and neoxanthin,

(Guerra et al., 2005). β-cryptoxanthin epoxide, β-carotene, lutein 5, 6 epoxide (Rodriguez-Amaya, 1999b).

Anticancer Activity

EO of the seed, especially linalool is a major component showing anticancer activity. As expected the compound inhibits cell proliferation reasonably and develops a therapeutic directory of anthracyclines in the administration of human breast cancer, particularly in multidrug challenging tumours (Ravizza et al., 2008). Coriander leaves and seeds extracts showed *in vitro* antitumor and immune-modulating activity whereas root extracts showed anti-proliferative activity against human breast cancer cell lines (Table 1). This put forward its potential in the prevention of cancer and metastasis inhibition (Gomez-Flores et al., 2010). The anti-tumorigenic properties of coriander accredit its defensive function alongside the injurious property in the metabolism of lipids connected through this melanoma in investigational colon cancer cells. The functional supplements used in combination with conservative drugs improve the treatment of cancer (Chithra and Leelamma, 2000).

Activity against Indigestion

The coriander has been justified for the comprehensive animal study. The digestive refreshment action might be measured through liver stimulation to secrete more bile enriched in bile acids, and enzyme encouragement activities contributing indigestion, in cooperation of intestinal and pancreatic origin. Such motivation activities of digestive enzymes lead to an accelerated in general digestive process (Platel and Srinivasan, 2004).

Table 1. Pharmacological Studies for *Coriander sativum*

S.No.	Activity	Extract type	Models/dosage used	References
1	Antibacterial	Fruits EO	*In vitro*, bacterial skin infections (0.04–025% v/v)	Casetti et al., 2012
2	Antifungal	Leaves EO	*In vitro* and micro-dilution techniques (1000–0.48 μg/mL)	Freires et al., 2014
3	Antioxidant	EtOH, MeOH, DCM, extracts of seeds & leaves	*In vitro* DPPH assay, inhibition of 15-lipoxygenase, inhibition of Fe^{2+} induced porcine brain, phospholipid peroxidation (167 μg/mL)	Al-Mofleh et al., 2006
4	Anticancer	MeOH and H_2O extracts of leaves and seeds	*In vitro*, mouse, lymphoma cell line L5178Y-R (7.8–125 μg/mL)	Gomez-Flores et al., 2010
5	Anthelmintic	H_2O and H_2O-EtOH extracts of seeds	*In vitro, in vivo* study in infected sheep with *Haemonchus contortus* (0.5–0.12–0.18 mg/mL, 0.45 and 0.9 g/kg)	Eguale et al., 2007
6	Anti-convulsant	H_2O and EtOH extracts of seeds	*In vivo* in mice, pentylenetetrazole and maximal electroshock tests (H_2O Ex. 0.05, 0.2, 0.35 & 0.5 g/kg; EtOH: 0.5, 2.0, 3.5 & 5 g/kg)	Chithra and Leelamma, 2000
7	Anti-inflammatory	Aerial parts EO	Clinical study, ultraviolet erythema test (0.5% and 1.0%)	Reuter et al., 2008
8	Anxiolytic	H_2O extract of seeds	*In vivo* in mice, elevated plus-maze test (50, 100 and 200 mg/kg)	Pathan et al., 2011
9	Hypo-lipidemic	H_2O extract of seeds	*In vivo* in rats, normal and obese-hyperlipidemic; hypercaloric diet and forced limited physical activity in rats (20 mg/kg, daily dosing for 30 d, sub-chronic study)	Aissaoui et al., 2011
10	Insecticidal	Aerial parts EO	*In vitro* study of eggs, larvae and adults of *Tribolium Castaneum*. Filter paper arena test (2, 4, 8 and 12 μg dissolved in 1 mL acetone)	Islam et al., 2009
11	Memory-enhancing	Fresh leaves	*In vivo* in rats, elevated plus-maze served as exteroceptive behavioural model (5, 10 and 15% w/w in normal animal diet 45 d)	Mani and Parle, 2009
12	Sedative hypnotic	Seeds EO, H_2O and H_2O-EtOH extracts	*In vivo* in mice, treatments were carried out for 30 min (100, 200, 400 and600 mg/kg)	Emamghoreishi and Heidari-Hamedani, 2006

CONCLUSION

The current assessment summarizes a number of frequent reports on the phytochemical composition of seeds and aerial parts (herb) along with their different biological activity. Bioactive constituent stating modern journalism and supports coriander potentially as an important medicinal plant. It has unfolded its use as conventional medicine that has been engaged medicinally in unthinking airway diseases such as bronchiolitis and asthma. The broad spectrum of pharmacological effects *in vivo* and *in vitro* studies have been performed on this medicinal plant. It has numerous biological properties like antioxidant, antimicrobial, hypoglycemic, anxiolytic, hypolipidemic, analgesic, anticonvulsant, anti-inflammatory and anticancer activities.

In addition, a synergic consequence has been established for the antibacterial and antifungal activity of EO and conventional antibiotics/antifungal agents show the potential antifungal activity of the coriander EO as a potential source for the management of oral diseases.

Moreover, as a supplement, Dhania might be functional in amalgamation with predictable drugs to improve the treatment of cancer and Alzheimer disease. Optimistically, the bioactive constituents of Dhania seeds and leaves and their different types of biological activities determined are accommodating to generate more attention towards coriander through important novel clinical and pharmacological applications and therefore, might be functional in mounting novel drug formulations in opportunity.

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