wjpmr, 2024, 10(2), 183-190

SJIF Impact Factor: 5.922

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Review Article

ISSN 2455-3301

WJPMR

IN-DEPTH REVIEW ON PHYTOCHEMICALS AND MEDICINAL PROPERTIES OF CORIANDRUM SATIVUM

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Article Received on 20/12/2023 **Article Revised on 10/01/2024** **Article Accepted on 30/01/2024**

ABSTRACT

The common name for the plant *Coriandrum sativum* is Dhaniya. It is an annual plant that has long been used as a spice. This plant's young leaves are referred to as cilantro. This plant's edible seeds, leaves, and fruits are used as a flavoring in soups, curries, and other Indian foods. They also have a fragrant scent. The fruit of this species of plant is used to make curry powder and various flavors, as well as pastries, buns, and cakes. The therapeutic value of coriander seeds is widely recognized. In particular, the seeds of this plant are traditionally utilized by many tribes to treat a variety of illnesses and to prepare Ayurvedic remedies. *Coriandrum sativum* was shown to include flavonoids, phenolics, tannins, terpenoids, reducing sugars, essential oil, fatty acids, sterols, and glycosides by phytochemical screening. High nutritional qualities were also included in it, including proteins, fats, carbs, fiber, and a variety of minerals, trace elements, and vitamins. It has been shown in prior pharmacological studies to have a variety of pharmacological effects, including those that are anxiolytic, antidepressant, sedative-hypnotic, anticonvulsant, improving memory, protective of neurons, antimicrobial, antifungal, anthelmintic, insecticidal, antioxidant, heart disease., anti-inflammatory, analgesic, antidiabetic, gastrointestinal, deodorizing, dermatological, diuretic, reproductive, liver-protective, detoxification, and many more. The purpose of this paper is to provide an overview of the medicinal effects and chemical makeup of *Coriandrum sativum.*

KEYWORDS: Diuretic, Anti-oxidant, Phytochemicals, Neuroprotective, Herbs, Coriander.

INTRODUCTION

Herbal medicine has been around for a while and is still very popular. Numerous researchers have taken notice of this and been inspired to screen medicinally interesting plants in order to investigate the biological activities of their bioactive chemicals. As a result, a large body of research on the biological properties of several medicinal plants' bioactive chemicals has been done.[1-3]

The Apiaceae family plant coriander (Coriandrum sativum L.) is an important and fascinating example of a therapeutic plant. Originating in the Mediterranean region, this annual herbaceous plant is widely grown for culinary and medicinal purposes throughout North Africa, Central Europe, and Asia. It can also be cultivated effectively in a variety of environments.[4] Whole dried seeds are pulverized and used extensively in Mediterranean cuisine as a spice or condiment, or as a main component of curry powder. Additionally, seeds are used to flavor a variety of dishes, including meat and fish as well as baked goods and confections. Furthermore, the fresh leaves generally referred to as cilantro are widely used in Indian and eastern cuisines as culinary flavorings or to cover up offensive aromas from specific

dishes. They are a key component in Thai and Vietnamese cooking as well.[5] It is interesting to note that traditional medicine has used all components of this plant as traditional treatments to cure a variety of ailments. Coriander leaves increase appetite and aid in simple digestion, while coriander seeds have been utilized for treating a variety of digestive issues, including constipation, nausea, and dysentery.[6,7]

Biological source

Coriander consists of dried ripe fruits of Coriandrum sativum Linn., belonging to family Apiaceae

Vernacular name[8-14]

Hindi	Dhania, Dhanya
English	Coriander, Cilantro
Sanskrit	Dhanayaka, Kusthumbari
Gujarati	Dhana
Tamil	Kotthambari
Malayalam	Malli, Kothaambala, Kothambalari
Kannada	Kotthambari
Bengali	Dhane
Arabic:	Kuzbara, Kuzbura
Swedish	Coriander
Japanese	Koendoro
German	Koriander, Wanzendil
Greek	Koriannon
Chinese	Yuan Sui
Italy	Coriandolo
Malaysia	Ketumbar, Penjilang
Thailand	Phakhchi, Phakhom,
USA	Cilantro

Taxonomic classification[15-18]

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Apiales
Genus	Coriandrum L
Species	*Coriandrum sativum* L
Family	Apiaceae

Botanical description

The annual herb coriander (Coriandrum sativum L.) is a member of the Apiaceae family. The soft coriander plant is native of southern Europe, northern Africa, and south-western Asia. It may grow up to 50 cm (20 in) tall. The leaves have different shapes; they might be thickly lobed near the base of the plant or thin and feathery higher up the blooming stalks. Both annual and perennial coriander grows. This herb has flowers and is typically identified by its upright, glabrous, and heavily branched plant. The coriander plant has a well-developing taproot and ranges in height from 0.2 to 1.4 meters. Coriander stems are typically tall, sympodial, and monochasial branching, however occasionally they have multiple lateral shoots at the base terminal. An inflorescence finishes each branch. When the ribbed stem is at the flowering stage, its green hue changes to red or violet. A fully developed plant has a hollow stem with a 2 cm diameter at the base.

The size, shape, and quantity of coriander leaves vary. They are oddly margined, have a sheath enclosing them, and are colored yellow-green. Comprised to three quarters of its circumference is made up of the supporting stem.The blooms are exquisitely beautiful, pale mauve, nearly white, and borne in umbels with short stems and five to ten rays. When the seeds are ready to fall, the clusters of seeds exhibit remarkable symmetry. The fruit, called a cremocarp, divides into two mericarps that hang around on the carpophores for a while. The plant has a strong odor and is glabrous, brilliant green, and shiny.[19–23]

Fig. 1: Coriander leaves.

Fig. 2: Coriander flowers.

Fig. 3: Coriander seeds.

Geographical distribution[24-26]

Since human history, coriandrum sativum has been grown. It is said to have originated in the Eastern Mediterranean and spread as a spice plant to India, China, Russia, Central Europe, and Morocco. But now it was spread throughout Europe (Denmark, Finland, Ireland, Norway, Sweden, UK, Austria, Belgium, Czechoslovakia, Germany, Hungary, the Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Portugal and Spain), Asia (Afghanistan, Morocco, Tunisia and Ethiopia), and Northern Africa (Algeria, Morocco, Tunisia and Ethiopia). It is grown in Maharashtra, Uttar Pradesh, Rajasthan, Jammu, and Kashmir in India.

Phytochemical constituents of *coriandrum sativum*

The therapeutic remedy *Coriandrum sativum* L. is indigenous to the eastern Mediterranean region. It may have spread to India, China, and other parts of the world along with many other fragrant plants. The primary secondary metabolic product of coriander in this context is the essential oil. Still another set of active ingredients will be covered in this compilation, though.

Sugars, alkaloids, flavones, tannins, resins, anthraquinones, sterols, and fixed oils are all present in the fruits. It is possible to argue that the fatty and essential oils found in coriander fruits are their most significant components. Petroselinic acid (cis-6-octadecenoic acid, 18:1), linoleic acid (18:2), oleic acid (18:1), and palmitic acid (16:0) are the fatty acids found in coriander fruits.[16,17] According to reports, coriander, like all other green leafy vegetables, is high in vitamins (high concentrations of vitamin A/β-carotene: 12 mg/100 g and vitamin C: 160 mg/100 g), low in cholesterol and saturated fat, and an excellent source of thiamine, zinc, and dietary fiber in addition to minerals and iron. 84% of unripe coriander is water. Here, the order of importance for the phytoconstituents will be discussed.[27–33]

1. Essential oils

Coriander fruits contain about 0.2–1.5% of essential oil and 13–20% of vegetal oil (fixed oil); however, it has been recorded that some cultivars contain essential oil up to 2.6%.[27] Another literature mentioned that coriander contains up to 1% essential oil where monoterpenoid linalool is the major compound (>50%), and limonene, camphor, and geraniol are present in significant quantity. Sometimes, the essential oil of the coriander obtained from the fruits was recorded approximately as 0.5–2.5%. It seems that different cultivars andregions have been present in a different ratio of the essential oil concentration. However, in the majority of studies the main component is defined as linalool (60-70%).[28,29] sometimes up to 87.54%. In addition, α-pinene, camphor and geraniol are also known as other important components and are responsible for the character of fragrance and aroma of the plant. The investigation on two coriander varieties (*vulgare* and *microcarpum*) from Turkey has resulted in oil content like 0.15–0.25% in *vulgare* (linalool 42.1–52.7%); and 0.31–0.43% in

microcarpum (linalool 63.5–71.0%).[9] In Iran, the essential oil from the dried fruit of the coriander has been found in the range of 0.1–0.36% represented by 34 compounds, linalool (40.9–79.9%) as major component.[34]

2. Fatty acids

Particularly from French origin (23% yield), the vegetal oil (fixed oil/fatty oil) of coriander fruits has a significant concentration of monounsaturated fatty acids (1.8%); in particular, petroselinic acid (73%) is present.[31,35] Coriander vegetable oil has been classified as a Novel Food Ingredient (NFI) and is safe for healthy individuals to use up to 600 mg of it daily as a dietary supplement.[31] Because petroselinic acid is present in the essential oil of C. sativum fruits, it is known as triglyceride oil. The plant is known to be a possible source of essential oil (high in linalool) and lipids (rich in petroselinic acid) that may be extracted from the fruits and aerial portions.[29] Coriander becomes more valuable and intriguing when petroselinic acid is present.

3. Polyphenols

Because of their potent biological effects, coriander fruits and leaves contain polyphenols, which are very significant secondary metabolites. Fruit phenolic components have often been identified as flavones, tannins, and anthraquinones.[30] Using LC/MS, some phenolic chemicals in coriander leaves might be made to appear somewhat familiar. Quercetin-glucuronide has been identified as the primary component in plant parts, leaves, and fruits based on the polyphenol profile between them.[36] Additionally, coriander leaves have significant concentrations of gallic, ferulic, caffeic, and chlorogenic acids.[37]

4. Carotenoids

Market coriander types underwent HPLC/MS analysis to determine their carotenoids content, namely β-carotene (a precursor to vitamin A). The mature leaves of all kinds produced under similar circumstances had a greater level of β-carotene content than the seedlings and seeds. At the pre-flowering stage, for instance, one variety yielded the largest amounts of biomass (6.18 ± 0.73 g/plant), total carotenoids (217.50 ± 5.6 mg/100 g DW), and β-carotene (73.64 ± 0.3 mg/100 g DW). Comparing microwave and oven drying methods for leaves, the findings indicate that microwave drying preserves colors and trans-β-carotene.[38] The carotenoid content such as *β*-carotene, *β*-cryptoxanthin epoxide, lutein- 5,6-epoxide, violaxanthin, and neoxanthin from the ether extract of coriander, the *β*-carotene was represented 61.14% of the carotenoids detected in the extract.[39]

5. Isocoumarins

There aren't any current publications on coriander's isocoumarins. From the aerial portions of C. sativum, the isocoumarins coriandrones A and B, coriandrin, and dihydrocoriandrin were extracted.[40] Furthermore, coriandrones C–E were also separated from methanolic extracts of the coriander aerial parts grown at the Osaka University of Pharmaceutical Sciences botanical garden.[41] The photoactive components of coriander extracts were examined using photobiological test and HPLC. In a similar manner, photoactive furoisocoumarins known as coriandrin and dihydrocoriandrin were also isolated, and X-ray crystallography were used to identify their structures.[42]

Medicinal properties of *coriandrum sativum*

1. Diuretic effects

The application of coriander for its diuretic plant in Moroccan pharmacopoeia is validated by the aqueous extract of coriander seed, which has both saluretic and diuretic activity. Aqueous extract of coriander seed was given to anesthetized Wistar rats by continuous intravenous infusion for 120 minutes at two doses (40 and 100 mg/kg). The common diuretic furosemide (10 mg/kg) was utilized as the reference medication. Urine was tested for the excretion of water and electrolytes (sodium, potassium, and chloride), and the glomerular filtration rate—which is equivalent to creatinine clearance—was calculated. Furosemide had more diuretic and saluretic potency than the crude aqueous extract of coriander seeds, which also raised glomerular filtration rate and electrolyte excretion in a dose-dependent manner. The plant extract's mode of action seems to be comparable to furosemide's.[43]

2. Anti-inflammatory effect

Maharasnadhi Quather (MRQ), a traditional Sri Lankan formulation, has been shown to have anti-inflammatory and analgesic effects in both human and animal models. Its primary ingredient is coriander seeds. Giving MRQ supplements to individuals with rheumatoid arthritis, inflammation of the liver, and gastrointestinal disorders results in an effective outcome. Another study on coriander oil included 40 participants who evaluated the anti-inflammatory properties of a lipo lotion enriched with 0.5% and 1% coriander oil. Effectively, lipopolotion reduced the erythema caused by UV light.[44–46]

3. Anticancer activity

Rats have been used to study the biochemical impact of coriander fruits on lipid parameters in colon cancer induced by 1, 2-dimethylhydrazine. In the 1, 2-dimethylhydrazine control group, phospholipid levels significantly rose while cholesterol concentrations and the cholesterol to phospholipid ratio decreased as compared to the coriander-administered group. The group given coriander exhibited a significant increase in fecal dry weight, fecal neutral sterols, and bile acids as compared to the group provided DMH. Therefore, it appears that coriander protects against colon cancer's lipid metabolism. While research on coriander's anticancer properties is few, several studies have been conducted based on its antioxidant properties.[47]

4. Antimicrobial activity

The antimicrobial activity of the coriander has been arisen from the essential oil content. The spice, C. sativum is one of the plants that are known to produce essential oils with antimicrobial activity .. 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. The essential oil showed pronounced antibacterial activity against all of the microbes tested except for P. aeruginosae, B. cereus and enterococcus faecalis , 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 diseases as determined with the agar diffusion method whereas F. vulgarevar. showed a much reduced effect.[48]

5. Sedative and Hypnotic activity

Iranian traditional medicine has advised Coriandrum sativum L. as a sleep aid. To measure the hypnotic and sedative effects Rats are given aqueous and hydroalcoholic extracts as well as essential oils. The experiment's findings demonstrate that at 200, 400, and 600 mg/kg of pentobarbital, the duration of sleep was lengthened by an aqueous extract. In comparison to the group treated with saline, the pentobarbital-induced sleeping period was prolonged by hydro-alcoholic extract at dosages of 400 and 600 mg/kg. Only at 600 mg/kg did the essential oil prolong the period that pentobarbital caused sleep. Coriander seed extracts and essential oil have sedative-hypnotic properties.[49]

6. Antioxidant effects activity

Because coriander contains both antioxidant and anti-inflammatory components, adding it to meals enhanced its antioxidant capacity. It suppressed undesirable oxidation processes and was a strong natural antioxidant. Compared to the seeds, the coriander leaves had higher antioxidant activity. According to a paper, antioxidant activity was shown by seed aqueous extracts both in vitro and in vivo.[50,51]

7. Antidiabetic activity

Rats given a high-fat diet with additional cholesterol were used to study the effects of coriander seed administration on lipid metabolism. Coriandrum sativum seeds were included in the diet. The seeds exhibited a notable hypolipidemic effect. The level of total cholesterol and triglycerides increased considerably in the experimental group of rats (tissue). The experimental group exhibited a noteworthy elevation in plasma lecithin cholesterol acyl transferase activity (LCAT) and β-hydroxy, β-methyl glutarylCoA reductase. When comparing the experimental group to the control group, the levels of low density lipoprotein (LDL) and very low density lipoprotein (VLDL) cholesterol dropped while the levels of high density lipoprotein (HDL) cholesterol rose. The increased activity of plasma LCAT, enhanced degradation of cholesterol to fecal bile acids and neutral sterols appeared to account for its hypocholesterolemic effect.[52]

8. Anti-convulsant activity

To assess the fokloric usage of this plant, researchers looked at the anti-convulsant properties of coriander sativum seed extracts in both aqueous and ethanolic forms. The antiseizure action was evaluated using two anti-convulsant assessment tests: the maximum electroshock test and pentylenetetrazole (PTZ).Aqueous and ethenolix extracts delayed the beginning of clonic convulsions in the pentylenetetrazole test, and their anticonvulsant effect at a high dosage (5 mg/kg) was comparable to that of phenobarbital at a dose of 20 mg/kg in the PTZ test. In the maximum electroshock test, both extracts demonstrated statistically significant anticonvulsant action and reduced the duration of tonic seizures at high dosages.[53]

9. Cardioprotective effects

It has been discovered that coriander fruit hydro-methanolic extract has potential cardioprotective effects. This result should also be explained by the fruits' high polyphenol content. Using an isoproterenol-induced cardiotoxicity model in male Wistar rats, researchers examined the protective effects of coriander on cardiac damage and discovered that the fruits' methanolic extract prevented myocardial infarction by preventing myofibrillar damage in the rats.[54] While the extract decreased high-density lipoprotein (HDL) cholesterol and increased the cardioprotective indicators, the coriander fruits significantly decreased all cholesterol-associated lipids. In rabbits, coriander fruits also decreased dyslipidemia. Along with the coriander diet, all blood-fat levels improved dramatically. This indicates that the extracts' cardioprotective action is profitable.[37]

10. Anthelmintic effects

The aqueous extract of coriander was found to have in vivo anthelmintic activity in sheep infected with Haemonchus contortus, while the crude aqueous and hydroalcoholic extracts of the fruits of Coriandrum sativum were studied for their anthelmintic properties (in vitro) on the egg and adult nematode parasite known as Haemonchus contortus. Eggs were fully blocked from departing by both extract types when the concentration was less than 0.5 mg/mL. The hydroalcoholic extract's ED50 was reported to be 0.18 mg/mL, whereas the aqueous extract's was 0.12 mg/mL.[55] Furthermore, after five days in chickpea grains, every essential oil dose exhibited a notable degree of toxicity to the bug Sitophilus granaries.[56]

11. Antiulcer effects

One plant that may help shield the body from absorbing heavy metals and other food poisons is coriander. Additionally, the plant may be able to stop Helicobacter pylori and stomach ulcers from developing. The

antigastric ulcer and antisecretory properties of coriander have been demonstrated in research, which also suggests that the effect may be attributed to the antioxidant properties of various coriander constituents that are involved in scavenging reactive oxygen species on the gastric mucosa's surface or may form a protective layer through hydrophobic interactions. For this reason, it shields the cells from gastrointestinal harm.[57] In a recent work, the animal study showed that coriander fruits (250 mg/kg and 500 per os) protected the animals against the ulcerogenic effects of salt, sodium hydroxide, ethanol, indomethacin, and pylorus ligation dose-dependently.[37]

CONCLUSION

Because of its culinary and medicinal qualities, coriandrum sativum is an ancient spice that is utilized in many different civilizations around the world. It is a component of practically all conventional medical systems. It is primarily used in Ayurveda to improve digestion and appetite as well as balance the three doshas. In contrast, the folk system mostly uses it for baking and cooking. In another culture, it is used in a different way. Every portion of the coriander plant has a pleasant perfume and contains valuable phytochemicals with a range of biological effects, including antibacterial, antioxidant, anti-mutagenic, anxiolytic, sedative, neuroprotective, anti-diabetic, diuretic, and anti-hypertensive effects.

CONFLICT OF INTEREST

The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ACKNOWLEDGEMENT

The authors are thankful to their institutes.

FUNDING

None

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