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Medicinal benefits of coriander (*Coriandrum Sativum* L)

Kişnişin (*Coriandrum Sativum* L) Tıbbi Faydaları

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ABSTRACT

Medicinal plants have therapeutic potential due to the presence of natural antioxidants functioning as reducing agents, free radical scavengers and quenchers of singlet oxygen. Majority of their antioxidant activity is due to bioactive compounds viz. flavones, isoflavones, flavonoids, anthocyanins, coumarins, lignans, catechins and isocatechins. Currently there has been an increasing interest to identify the antioxidants that are pharmacologically potent with low or no side effects for use in preventive medicine. Spices have been recognized to possess several medicinal properties (diuretic, expectorant, laxative, anti-bacterial, anti-pyretic etc.) and have been effectively used in the indigenous systems of medicine in India and other countries. Apart from the traditional use, a no. of beneficial physiological effects have been identified by extensive animal studies. Among these are their beneficial effects on lipid metabolism, efficiency as antidiabetics, ability to stimulate digestion and to inhibit platelet aggregation, antioxidant, antilithogenic and anti-inflammatory potential. Many spices and their active principles are reported as excellent nutraceuticals. Coriander is among such most commonly used spices, possessing the nutritional as well as medicinal properties, widely distributed and mainly cultivated for the seeds which contain an essential oil and the monoterpenoid-linalool. Coriander is used in the preparation of many household medicines to cure bed cold, seasonal fever, nausea, vomiting, stomach disorders and also used as a drug for indigestion, against worms, rheumatism and pain in the joints. Many of healing properties of coriander can be attributed to its exceptional phytonutrients and hence, it is often referred to as store house for bioactive compounds.
Keywords: Spices, coriander, phytonutrients, diuretic, expectorant, laxative, anti-bacterial, anti-pyretic, hypoglycemic.

ÖZET

Tıbbi bitkiler, indirgeyici ajanlar, serbest radikal süpürücüleri ve singlet oksijen baskılayıcıları gibi doğal antioksidan fonksiyonların varlığı sayesinde tedavi edici potansiyele sahiptirler. Bu bitkilerin antioksidan etkinliklerinin çoğu, flavonlar, izoflavonlar, flavonoidler, antosiyaninler, kumarinler, lignanlar, katekinler ve izokatekinler gibi bioaktif bileşikler sayesindedir. Günümüzde, koruyucu hekimlikte kullanılmak üzere düşük yan etkili veya yan etkisi olmayan farmakolojik olarak etkin antioksidanları saptamak için artan bir ilgi söz konusudur. Baharatların birkaç tıbbi özelliği (diüretik, ekspektoran, laksatif, antibakteriyel, antipiretik vb.) sahip olduğu bilinmektedir ve Hindistan ve diğer ülkelerde, yöreye özgü doğal tıpta etkin bir şekilde kullanılmışlardır. Geleneksel kullanımlarının dışında, faydalı fizyolojik etkilerinin sayısı yaygın hayvan çalışmaları ile tespit edilmiştir. Bunların arasında, lipit metabolizması üzerine faydalı etkileri, antidiyabetik olarak etkinlikleri, sindirimi uyarma yetenekleri ve platelet agregasyonunu inhibe etmeleri, antioksidan, antilitojenik ve antienflematuar potansiyelleri vardır. Birçok baharat ve aktif kökenleri, mükemmel nutrasötikler olarak rapor edilmektedir. Tıbbi olduğu kadar besleyici özellikleri de olan Kişniş, bu gibi çok yaygın olarak kullanılan ve geniş bir dağılımı olan baharatlar arasındadır ve başlıca esansiyel bir yağ ve monoterpenoid-linalol içeren çekirdekleri için ekilir. Kişniş, grip, mevsimsel ateş, bulantı, kusma, mide rahatsızlıklarının tedavisi için birçok evyapımı ilacın hazırlanması için kulanılmaktadır ve hazımsızlık, barsak kurtları, romatizma ve eklem ağrıları için bir ilaç olarak da kullanılmaktadır. Kişniş'in iyileştirici özelliklerinin çoğu, onun olağanüstü bitkisel besin olmasına atfedilebilir ve bundan dolayı, sıklıkla biyoaktif bileşikler için bir ambar olarak adlandırılır.
Anahtar Kelimeler: Baharatlar, kişniş, bitkisel besinler, diüretik, ekspektoran, laksatif, antibakteriyel, antipiretik, hipoglisemik.

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INTRODUCTION

Plants constitute an important source of natural products which differ widely in their structures, biological properties and mechanism of action. Various phytochemical components especially polyphenols, flavonoids, phenolic acids etc. are responsible for the free radical scavenging and antioxidant activity of the plants. Polyphenols possess many biological affects, mainly attributed to their antioxidant activities in scavenging free radicals, inhibition of peroxidation and chelation of transition metals [1].

In view of deleterious side effects of synthetic anti-oxidant supplements on human health, the present day's focus is on antioxidants from natural sources [2]. In spite of the advent of modern high throughput drug discovery and screening techniques, traditional knowledge systems have given clues to the discovery of valuable drugs [3]. Traditional medicinal plants are often cheaper, locally available and easily consumable, raw or as simple medicinal preparations. Considerable research on pharmacognosy, chemistry, pharmacology and clinical therapeutics has been carried out on Ayurvedic medicinal plants in order to establish the scientific basis of their therapeutic potentials [4]. Herbs and spices have only recently captured the attention of the scientific community as store house for bioactive compounds providing potential health benefits. As a result, there needs to be significant investment in human clinical trails to substantiate many of the hypothesized health benefits.

Coriandrum sativum L. (Coriander)

Coriandrum sativum L. is an important spice crop and occupies a prime position in flavoring substances. Coriander is available throughout the year providing a fragrant flavor that is reminiscent of both citrus peel and sage, originated around the Mediterranean and is cultivated mainly in the tropical areas. The main coriander growing states in India are Andhra Pradesh, Rajasthan and Tamilnadu. The seeds are used in medicine as a carminative, diuretic and also used in the preparation of many house hold medicines to cure bed cold, seasonal fever, nausea, and stomach disorders. Coriander seeds contain petroselinic acid, linoleic acid, oleic acid and palmitic acid (Table1). Major components of essential oil are linalool, a-pinene, camphor and geraniol (Table 2). Coriander oil is used in baked foods, condiments and also functions as an essential ingredient in curry mixes [5].

The study of antioxidants that are ubiquitously present in spices is gaining momentum in human health, as these are easily absorbable in human system. Among such plants, Coriandrum sativum is well known for its antioxidant properties and some of its active components have been identified. Coriander contains active phenolic acid compounds, including caffeic and chlorogenic acid. The flavonoids include quercetin, keampferol, rhamnetin and apigenin**.** Most of these compounds are known to inhibit free radicals generated in the cellar system, when they are obtained through the diet. While there is still limited understanding of the mechanisms through which they act, initial research indicates that Coriandrum sativum is effective as both a treatment and preventive agent for several chronic diseases [6].

Table 1. Fatty acids in coriander seeds

Main Components	% of all fatty acids
Petroselinic acid	68.6
Linoleic acid	16.6
Oleic acid	7.5
Palmitic acid	3.8

(Minor Components: Stearic acid, Vaccenic acid, Myristic acid)

Table 2. Essential oils in coriander seeds

Main Components	% total essential oil
Linalool	67.75
alpha-pinene	10.5
Gamma-terpinene	9.0
Geranylacetate	4.0
Camphor	3.0
Geraniol	1.9

Botanical Description

Coriandrum sativum L. belongs to the family Umbelliferae with botanical classification:

Division : Angiospermae
Class : Dicotyledonae
Sub-class : Calyciflorae
Order : Umbellales
Genus : Apiaceae
Species : Umbellifera

Table 3. Nutrient composition /100g

Composition	USDA
Water (g)	7.3
Food energy (kcal)	279.00
Protein (g)	21.83
Fat (g)	4.76
Carbohydrates (g)	52.10
Ash (g)	14.02
Calcium (mg)	1.246
Phosphorus (mg)	481.00
Sodium (mg)	211.00
Potassium (mg)	4.466
Iron (mg)	42.46
Vit –C (mg)	566.7

Fig 1. Coriander (*Coriandrum sativum*L.) plant

The genus *Coriandrum* L. has two species, *C. sativum* L. is coriander, approximately 30–100 cm in height, with strong-smelling leaves [7] (Fig.1). The mature fruits have a fresh and pleasant flavour and are largely used all over the world in ground or volatile isolate form for flavouring sweets, beverages, tobacco products and baked goods and as a basic ingredient for curry powder. The essential oil obtained from its fruits at amounts ranging from approximately 0.5 to 2.5% is used both in flavours and in the manufacture of perfumes and soaps. It is cultivated as a domestic plant [8]. In commerce, coriander exists in two categories: the small-fruited *C. sativum* L. var. *microcarpum* DC and the larger-fruited *C. sativum* L. var. *vulgare* Alef. The former is exemplified by the volatile oil-rich Russian coriander, while the latter includes Moroccan, Indian and some other Asiatic types of coriander, all of which have very low volatile oil contents [9, 10].

Historical Cultivation and Usage

Cultivation: Coriander is a tropical crop; it requires a cool and comparatively dry frost, free climate particularly at the time of flowering and seed formation stages, for good quality and high yields. The optimum temperature of germination and early growth of coriander is 20^0-25^0C [11]

Nutrient composition: The nutrient composition [11] of coriander, commonly called as 'cilantro' is given in Table 3.

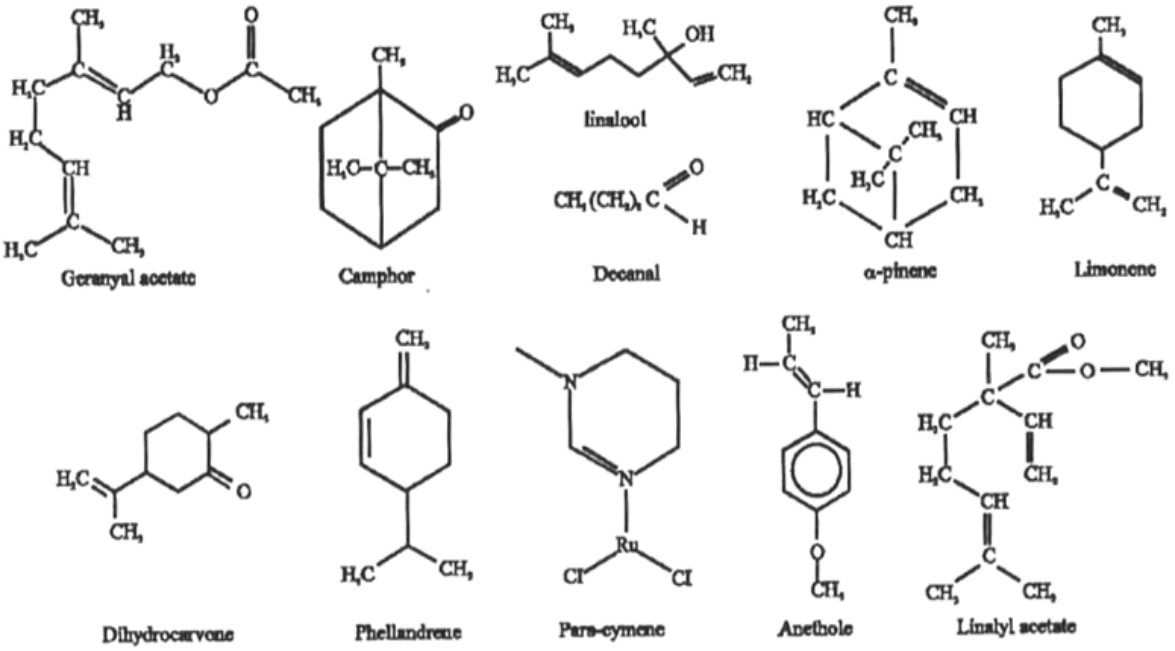

Fig. 2 Structures of the major compounds identified in the essential oil of coriander (*Coriandrum sativum* L)

Table 4. Chemical compounds in *Coriandrum sativum* L. and their biological activities

Sl No	Chemical Constituents	Anti tumor	Anti-inflammatory	Anti-aging	Anti-cancer	Anti oxidant	Anti diabetic	Anti microbial	Anti Ulcer
1.	Acetic acid (Fruit)							✓	
2.	Alpha-phellandrene							✓	
3.	Alpha-pinene		✓		✓			✓	
4.	Alpha-terpinene							✓	
5.	Alpha-terpineol							✓	
6.	Angelicin	✓						✓	
7.	Apigenin	✓	✓	✓	✓	✓		✓	
8.	Ascorbic acid (Leaf)	✓	✓	✓	✓	✓	✓	✓	✓
9.	Beta-carotene	✓		✓	✓	✓			✓
10.	Beta-pinene (Fruit)		✓						
11.	Beta-sistosterol	✓	✓		✓			✓	
12.	Borneol		✓					✓	
13.	Bornyl-acetate							✓	
14.	Caffeic acid	✓			✓	✓		✓	
15.	Camphene					✓			
16.	Carvone				✓				
17.	Caryophyllene	✓	✓					✓	✓
18.	Chlorogenic-acid (Plant)	✓			✓		✓	✓	✓
19.	Chromium (Seed)			✓			✓		
20.	Cis-ocimene (Fruit)							✓	
21.	Citronellol							✓	
22.	Copper		✓				✓		
23.	Dipentene							✓	
24.	Elemol								✓
25.	Fiber	✓			✓				✓
26.	Fructose						✓		
27.	Gamma-Terpinene					✓			
28.	Geranial	✓			✓			✓	
29.	Isoquercitrin	✓			✓	✓		✓	
30.	Limone	✓	✓					✓	
31.	Linoleic acid		✓		✓				
32.	Magnesium		✓				✓		
33.	Myrcene	✓						✓	
34.	Myristic-acid					✓			
35.	Myristicin		✓			✓			
36.	Nerol				✓			✓	
37.	Nerolidol							✓	
38.	Niacin				✓		✓		
39.	Oleic-acid		✓		✓				
40.	p-cymene							✓	
41.	p-hydroxy-benzoic acid	✓				✓		✓	
42.	Psoralen	✓			✓				
43.	Quercetin	✓	✓		✓			✓	
44.	Palmitic aci					✓			
45.	Pectin	✓					✓	✓	✓
46.	Protocatechuic acid	✓	✓			✓	✓		
47.	Rhamnetin		✓		✓			✓	
48.	Rutin	✓	✓		✓		✓	✓	
49.	Sabinene		✓					✓	✓
50.	Tannin	✓			✓			✓	✓
51.	Terpinen-4-0l					✓		✓	✓
52.	Terpinolene					✓			
53.	Trans-anethole					✓			
54.	Umbelliferone	✓	✓					✓	
55.	Vanillie acid	✓	✓		✓				
56.	Zinc						✓	✓	✓

Chemistry

The composition of the volatile oil, which determines the odour and flavour character, contain both steam – volatile and fixed oil. The volatile oil is rich in beneficial phytonutrients, including carvone, geraniol, limonene, borneol, camphor, elemol, and

linalool. In the unripe fruits and the vegetative parts of the plant, aliphatic aldehydes predominate in the steam-volatile oil and are responsible for the peculiar, fetid-like aroma. On ripening, the fruits acquire a more pleasant and sweet odour and the major constituent of the volatile oil is the monoterpene alcohol, linalool. The primary quality determinant of the spice is the content and composition of its steam-volatile oil. The volatile oil content of the spice can vary considerably according to the type and source and usually ranges from 0.1 to 1.7% and, in some cases, up to 2.7%. European coriander is mainly of the small fruited type and usually has volatile oil content greater than 0.4%, with the highest values exhibited by some Russian cultivars [9]. Moroccan and Indian coriander are mainly large-fruited types, and their volatile oil contents are usually less than 0.4%. During storage, some of the volatile oil can be lost by evaporation, but the rate of loss and the extent of organoleptic deterioration are dependent on the physical form of the spice and on the conditions and duration of storage. The most serious problem is encountered with ground coriander, which undergoes a rapid volatile oil loss and a marked organoleptic deterioration within a matter of weeks if left exposed to the atmosphere. Coriander oleoresin is prepared by solvent extraction of the spice. The oleoresin contains the volatile oil, fatty oil and some other extractives, but their relative abundance is dependent on the raw material, the processing procedure and the particular solvent used. Coriander oleoresins commonly contain about 90% fatty oil and about 5% steam-volatile oil [9].

Constituents identified in coriander essential oils

Coriander essential oil was reported to contain a no. of compounds [12, 13](Fig. 2).

Monoterpene Hydrocarbons: *p*-cymene, camphene, Δ-3-carene, limonene (dipentene), myrcene, *cis*- and *trans*-ocimene, α-phellandrene, β-phellandrene, α-pinene, β-pinene, sabinene, α-terpinene, γ-terpinene, terpinolene, α-thujene.

Monoterpene oxides and Carbonyls: Camphor, 1,8-cineole, linalol oxide, carvone, geranial.

Monoterpene Alcohols: Borneol, citronellol, geraniol, linalool, nerol, α-terpineol, 4-terpinenol.

Monoterpene Esters: Bornyl acetate, geranyl acetate, linalyl acetate, α-terpinyl acetate.

Sesquiterpenes: β-Caryophyllene, caryophellene oxide, elemol, nerolidol.

Phenols: Anethole, myristicin, thymol.

Miscellaneous compounds: Acetic acid, α-*p*dimethyl styrene.

Aliphatic Hydrocarbons: Heptadecane, octadecane.

Aliphatic Alcohols: Decanol, dodecanol.

Aliphatic Aldehydes: Octanal, nonanal, decanal, undecanal, dodecanal, tridecanal, tetradecanal, 3-octenal, 2-decenal, 5-decenal, 8-methyl-2-nonenal, 8-methyl-5-nonenal, 6-undecenal, 2-dodecenal, 7-dodecenal, 2-tridecenal, 8- tridecenal, 9-tetradecenal, 10-pentadecenal, 3,6-undecadienal, 5,8-tridecadienal.

Chemical constituents: The chemical constituents of the plant and their biological activities [14] are given in Table 4.

Culinary utility: Coriander as one of the first spices to be used as a common flavouring substance. The stem, leaves and fruits have a pleasant aromatic odour. The entire plant, when young, is used in preparing chutneys and the leaves are used for flavouring curries, sauces and soups; coriander oil and oleoresin are primarily used in seasonings for sausages and other meat products. They find application in baked goods, condiments, chewing gums, and also in curry mixes [5].

Medicinal and Pharmacological Properties

Health Benefits

Coriander seeds have a health-supporting reputation that is high on the list of the healing spices. In parts of Europe, coriander has traditionally been referred to as an "anti-diabetic" plant. In some parts of India, it has traditionally been used for its anti-inflammatory properties. In the United States, coriander has recently been studied for its cholesterol-lowering effects [15].

Antioxidant activity

The prefeeding of rats with coriander seed powder (CSP) at 10% level was found to reduce the experimentally-induced (HCH-induced) rise in conjugated dienes, hydroperoxide and malondialdehyde (MDA) contents in the liver. The intra peritonial injection of HCH reduced the activities of superoxide dismutase (SOD), catalase, glutathione-S-transferase (GST), glucose-6-phosphate dehydrogenase (G-6-PDH) and glutathione reductase (GSSGR) activities in liver, where as the hepatic glutathione peroxidase (GSH-Px) and kidney γ-glutamyltranspeptidase (GGT) activities were elevated. The prefeeding of CSP *per se* increased hepatic SOD, catalase, GST, G-6-PDH and GSSGR activities in CSP prefed and then HCH-administered rats. The work shows the modulation of hepatic antioxidant system as a result of the prefeeding of CSP, which were otherwise reduced by HCH injection. The results reported here elicit the antioxidative effect of coriander seeds against HCH-induced formation of free radicals in rat liver [16].

Leaf and seed extracts of coriander and coriander oil were tested for their antioxidant activity using different bioassay techniques. Positive correlations were found between total phenolic content in the extracts and antioxidant activity. Coriander leaves showed stronger antioxidant activity than the seeds

and, in both parts of coriander, the ethyl acetate extract contributed to the strongest activity. It was suggested that addition of coriander to food would increase the antioxidant content and may have potential as a natural antioxidant and thus inhibit unwanted oxidation processes [17]. The biochemical effects of coriander seeds (10% powdered seeds added to the diet) on tissue lipid parameters in 1,2-dimethyl hydrazine (DMH)-induced colon cancer in rats were studied after 15 and 30 weeks. The spice diet was given during the initial 15-week period of carcinogen administration only. The study shows that the concentrations of cholesterol and the cholesterol: phospholipids ratio decreased, while the level of phospholipids increased significantly in the DMH control group compared with the spice-administered group. Faecal dry weight, faecal neutral sterols and bile acids showed a sharp increase in the coriander-fed group compared with the DMH-administered group. Thus, coriander plays a protective role against the deleterious effects on lipid metabolism in experimental colon cancer [18]. Kaur and Kapoor [19] found that antioxidant activity correlated significantly and positively with total phenolics.

Hypoglycemic activity

Coriandrum sativum has been documented as a traditional treatment for diabetes. Coriander lowered the blood sugar when added to the diet of diabetic mice. The antihyperglycemic action of coriander is associated with stimulation of insulin secretion and enhancement of glucose uptake and metabolism by muscle, reflecting the effects of more than one active constituent. Coriander therefore, represents a possible antihyperglycemic dietary adjunct and potential source of orally active agent(s) for diabetes therapy [20].

Coriander incorporated into the diet (62.5 g/kg) and drinking water (2.5 g/l, prepared by 15 min decoction) reduced hyperglycemia of streptozotocin-diabetic mice. Aqueous extract of coriander (1 mg/ml) showed increases of 1.6-fold in 2-deoxyglucose transport and 1.4-fold in glucose oxidation and incorporation of glucose into glycogen (1.7-fold) comparable with 10–8 M-insulin. In acute 20 min tests, 0.25–10.00 mg/ml aqueous extract of coriander evoked a stepwise 1.3–5.7-fold stimulation of insulin secretion from a clonal B-cell line. Sequential extraction with solvents revealed insulin-releasing activity in hexane and water fractions, indicating a possible cumulative effect of more than one extract. These results demonstrate the presence of anti-hyperglycaemic, insulin releasing and insulin-like activity in coriander [21, 22].

Hypolipidemic activity

The biochemical effects of coriander seeds on lipid parameters in 1, 2-dimethyl hydrazine (DMH)-induced colon cancer in rats were studied. The study shows that the concentrations of cholesterol and cholesterol to phospholipid ratio decreased while the level of phospholipid increased significantly in the DMH control group compared to the spice administered group. Fecal dry weight, fecal neutral sterols and bile acids showed a sharp increase in the coriander-fed group compared with the DMH administered group. Thus, coriander plays a protective role against the deleterious effects in lipid metabolism in experimental colon cancer [23].

Ertas *et al*., [24] investigated the potential effects of dietary supplementation of coriander seed (considered as a lipolytic and antioxidant) on carcass lipid composition of quails. Dietary supplementation of coriander seed affected the lipid composition of carcass greatly by decreasing saturated fatty acid (SFA) contents (palmitic and stearic acids) and by increasing monounsaturated and polyunsaturated fatty acid (MUFA and PUFA) proportions in comparison with the control group ($p < 0.01$). The highest dosage of coriander seed (4% added to the ration) systematically induced the greatest effects on fatty acid composition. Some of the acids present in coriander viz. linoleic acid, oleic acid, palmitic acid, stearic acid and ascorbic acid (vitamin-C) are very effective in reducing the cholesterol level in the blood. They also reduce the cholesterol deposition along the inner walls of the arteries and veins.

Insecticidal effect

Pascual Villalobos [25] found the potential of plant essential oils against stored-product beetle pests. Coriander oil (10 µl) showed insecticidal activity against the bruchid *Callosobruchus maculates*, the cereal storage pest.

Aflatoxin control

The inhibitory effects of the essential oils of coriander on the mycelial growth and ochratoxin A production by *A. ochraceus* NRRL 3174 were studied by Basilico and Basilico, [26]. Meena and Sethi [27] also studied the potential of coriander oil in the control of *A. niger*, *Saccharomyces cerevisiae*, *Mycoderma* sp., *L. acidophilus* and *Bacillus cereus*.

Antibacterial activity

Essential oils from commercial samples of coriander were analysed by GC-MS and assayed for their antibacterial, antifungal and antioxidant activities. Twenty-five genera of bacteria and one fungal species (*Aspergillus niger*) were used as test organisms. The essential oils showed a high degree of inhibition against all the microorganisms tested [28]. Coriander

and basil were also highly inhibitory (MLC, 25 to 50 ppm) to *E. coli* O:157:H7 and to the other bacteria and fungi tested [29]. Pradeep *et al*.[30] reported the efficacy of coriander essential oil on seed mycoflora and seedling quality of some crop species. Tolkunova [31] investigated the influence of essential oils on microbiological indicators of meat products. The formulation of horsemint–fennel–coriander was found effective against Gram-positive microorganisms. Coriander (also called cilantro) contains an antibacterial compounds that may prove to be a safe, natural means of fighting *Salmonella*, a frequent and sometimes deadly cause of foodborne illness; Mexican researchers isolated the compound - dodecenal - laboratory tests showed that this is twice as effective as the commonly used antibiotic drug gentamicin at killing *Salmonella* where as most natural antibacterial agents found in food have weak activity [32, 33].

Antimutagenic potential

The antimutagenic activity of coriander juice against the mutagenic activity of 4-nitro-*o*-phenylenediamine, *m*-phenylenediamine and 2-aminofluorene was investigated using the Ames reversion mutagenicity assay (*his*$^-$ to *his*$^+$) with the *S. typhimurium* TA98 strain as indicator organism. The plant cell/microbe coincubation assay was used as the activating system for aromatic transformation and plant extract interaction. Aqueous crude coriander juice significantly decreased the mutagenicity of metabolized aromatic amines (AA) in the following order: 2-AF (92.43%) > *m*-PDA (87.14%) > NOP (83.21%). The chlorophyll content in vegetable juice was monitored and its concentration showed a positive correlation with the detected antimutagenic effect. The concentration of coriander juice (50–1000 µl/coincubation flasks) was neither toxic nor mutagenic. The similar shape of the antimutagenic response curves obtained with coriander juice and chlorophyllin (used as a subrogate molecule of chlorophyll) indicated that comparable mechanisms of mutagenic inhibition could be involved. The negative correlation between chlorophyll content and mutagenic response of the promutagenic and direct-acting used amines indicate a chemical interaction between the two molecules, leading to the inactivation of mutagenic moiety [34].

Other health benefits

Coriander also possesses many other health benefits which include control of swellings, diarrhea, mouth ulcers, anemia, menstrual disorders, small pox, eye care, conjunctivitis, skin disorders etc. [20].

Swellings: Cineole, one of the 11 components of the essential oils, and linoleic acid, present in coriander, possess antirheumatic and antiarthritic properties and are very beneficial to treat swelling caused due to malfunctioning of kidney or anemia as some of the components help excretion of extra water from the body.

Digestive health and control of diarrhea: Coriander, due to its rich aroma because of its essential oils, apart from being an excellent appetizer, helps in proper secretion of enzymes and digestive juices in the stomach, stimulates digestion and peristaltic motion. It is helpful in treating problems like anorexia. Some of the components of essential oils in coriander such as borneol and linalool, aid digestion, proper functioning of liver and bonding of bowels and help to cure diarrhea. It is also helpful to treat diarrhea caused by microbial and fungal action, since components like cineole, borneol, limonene, alpha-pinene and beta-phelandrene have anti-bacterial effects. In addition, the fresh coriander leaves are excellent appetizers.

Mouth ulcers: Citronelol, a component of essential oils in coriander, is an excellent antiseptic. In addition, other components have antimicrobial and healing effects which do not let wounds and ulcers in the mouth go worse. They aid healing up of ulcers and freshen up the breath.

Anemia: Coriander is good in iron content which directly helps curing anemia.

Small pox: The essential oils in coriander are rich in antimicrobial, antioxidant, anti -infectious and detoxifying components and acids. The presence of vitamin-C and iron strengthens the immune system too. These properties help, prevent and cure small pox. They also reduce the pain and have a soothing effect on pox patients.

Menstrual disorders: Being stimulating in nature and helping proper secretion from the endocrine glands, it also helps proper secretion of the hormones and thereby inducing proper menstrual cycles and reducing pains etc. during periods.

Eye care: Coriander has lots of antioxidants, vitamin-A, C and minerals like phosphorus in the essential oils which prevent aging of eye, macular degeneration and soothes eyes against stress. Coriander is a very good disinfectant and has antimicrobial properties which protect the eyes from contagious diseases like conjunctivitis.

Skin disorders: The disinfectant, detoxifying, antiseptic, antifungal and antioxidant properties of coriander are ideal for curing skin disorders such as eczema, dryness and fungal infections.

Coriander helps to cure ulcer, inflammation, spasm and acts as an expectorant, protects and soothes liver. It is anti-carcinogenic, anti-convulsant, anti-histaminic and hypnotic. Coriander is believed to be a natural aphrodisiac and previously it was extensively used in certain preparations, combined with other herbs [35]. Coriander essential oil evoked a marked analgesic

activity in mice in a study conducted by Afifi *et al*. [36].

CONCLUSIONS

Coriander (*Coriander sativum* L.) volatile oil is rich in beneficial phytonutrients and the seeds have a health-supporting reputation that is high on the list of the healing spices and has been used as antispasmodic, carminative, stimulant, cytotoxic, lipolytic, fungicidal and stomachic compound. Coriander also possesses hypoglycemic, hypolipidemic, antibacterial, antimutagenic activity, insecticidal and aflatoxin controlling effects. Besides, coriander also possesses many other traditional health benefits. The healing properties of coriander can be attributed to its exceptional phytonutrient content. Considering these potentials, coriander biomolecules possess a tremendous future in the health-related industry.

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