International Journal of Pharmaceutical Research and Development (IJPRD)
Platform for Pharmaceutical Researches & Ideas
www.ijprd.com

POTENTIAL HEALTH BENEFITS OF CORIANDER (CORIANDRUM SATIVUM): AN OVERVIEW

Leena Kansal[1*], Arti Sharma[1], Shweta Lodi[1]

[1]Department of Bioscience and Biotechnology, Banasthali University

ABSTRACT

The traditional Indian diet, spices, fruits and vegetables are rich sources of natural antioxidants, called as "functional foods" provide more than simple nutrition; they supply additional physiological benefit. Coriandrum sativum (common name: Coriander) belonging to family Umbelliferae, is an herb that is widely cultivated in India and possessing the nutritional as well as medicinal properties are among the most commonly used spices. The first medicinal uses of the plant were reported by the ancient Egyptians. Both the leaves and seeds of the plant are used for medicinal purpose. Coriander contains many active principles, primarily monoterpenes, α-pinene, limpnene, γ-terpinene, p-cymene, borneol, citronellol, camphor, geraniol, coriandrin, dihydrocoriandrin, coriandronsA-E, flavonoids and essential oils. Coriandrum sativum has been reported to have several pharmacological effects such as antifertility, antihyperglycemic, antihyperlipidmic, antioxidant, antiproliferative, hypotensive and digestive stimulant. Coriander is also used in detox diet. It helps to remove toxic mineral residue such as mercury and lead, and excrete them in the urine or faeces. This beneficial plant therefore is worthy of serious consideration for further investigation and clinical trials.

Key words: *Coriandrum sativum, antioxidant, flavonoids, antihyperglycemic, antihyperlipidic etc*

Correspondence to Author

Dr Leena Kansal

Department of Bioscience and Biotechnology, Banasthali University, District Tonk, Banasthali- 304022, Rajasthan, India

Email: leena.kansal@gmail.com

INTRODUCTION

Coriander (Coriandrum sativum, *Umbelliferae*) is native to Asia Minor. It is an essential ingredient in Asian cuisines, frequently used as a garnish and a flavoring agent. The name "coriander" is derived from the Greek word "kopis" which means "bug." The Greeks associated the peculiar odor, rather offensive to some, to that associated with bedbugs. The fresh leaves are referred to as "cilantro" while the seeds used as a spice are called coriander. *General references to coriander's medicinal uses are found in classical Greek and Latin literature [1] and instructions to cultivate coriander are contained in the German emperor Charlemagne's*

decree 'Capitulare villis' in 812 [2]. The medical uses of coriander in the morden era are described by Cicin, 1962 [3].

HISTORY

Coriander has a long history of use. It is mentioned in Sanskrit literature as far back as 5000 B.C. and in the Greek Eber Papyrus as early as 1550 B.C. [4]. Coriander was used in traditional Greek medicine by Hippocrates (ca. 460–377 B.C.). The seeds of coriander were found in the ancient Egyptian tomb of Ramses the Second. The Egyptians called this herb the ''spice of happiness", probably because it was considered to be an aphrodisiac. It was used for cooking and for children's digestive upset and diarrhea. The Greeks and Romans also used coriander to flavor wine and as a medicine [5]. Demand by the Romans for coriander was so great; it was imported from as far away as Egypt. Subsequently, it was introduced into Great Britain by the Romans [6]. The use of coriander to accelerate childbirth has been cited in manuscript illustrations (from the early 13th Century) on medieval midwifery [7]. Thus, the seeds (dried) have been in use for almost 7000 years [8]. The oil has been used as a food and fragrance ingredient since the 1900s [9].

Coriander is a native to the Mediterranean and Middle Eastern region [10]. The etymology of coriander starts with the Greek word korannon, a combination of koris and annon (a fragrant anise) and referred to the ripe fruit [11]. The Roman naturalist, Pliny the Elder, first used the genus name Coriandrum, derived from koris (a stinking bug), in reference to the fetid smell of the leaves and unripe fruit [12, 13].

COMMON NAMES OF SPECIES

Arab- kuzbara, Chienese- Hu- sui, Dutch- coriander, English- coriander, chienese parsley, French- corriandre, German- Koriander, Wanzendill, Hindi- Dhaniya, dhanya, Italian-coriandolo, Japanese- koendoro, Russian- koriandr, koljandra, Sanskrit- dhanayaka, kusthumbari, Spanish- coriandro, cilantro.

BOTANY AND DISTRIBUTION

Coriandrum sativum is an annual, herbaceous plant originally from the Mediterranean and Middle Eastern regions. Coriander is a weak stemmed glabrous plant, growing to about 60 cm height, all parts of the plant have a strong foetid odour, from which the plant takes its name. Coriandrum is derived from the Greek for a bug and refers to a shield-bug. The leaves are of two types, lower with leaflets and upper divided into narrow linear segments. Some varieties form a rosette of leaves at the base. The plant forms a tap root. Flowers are pink or white and small in small loose umbels. Inner flowers are smaller and sterile, outer ones with longer petals are fertile. Fruits are globose and approximately 3mm in diameter. They are glossy green, and ripen to a light yellow-brown color and are ribbed; each fruit contains 2 seeds [14].

It grows 25–60 cm (9–24 in.) in height. It has thin, spindle-shaped roots, erect stalk, alternate leaves and small, pinkish-white flowers. The plant flowers from June to July and yields round fruits consisting of two pericarps. The plant is cultivated for its aromatic leaves and seeds. There are two varieties of Coriandrum sativum: vulgare Alef. and microcarpum DC. These varieties differ in the fruit size and oil yield: vulgare has fruits of 3–5 mm diameter and yields 0.1–0.35 % essential oil, while microcarpum fruits are 1.5–3 mm and yield 0.8–1.8 % essential oil [15]. The phylogenetic classification of Coriandrum sativum is provided in Table 1.

Table 1- Describes general description and classification of coriander plant.

Kingdom	Plantae (plants)
Subkingdom	Tracheobionta (vascular plants)
Superdivision	Spermatophyta (seed plants)
Division	Magnoliophyta (flowering plants)

Class	Magnoliopsida (dicotyledons)
Subclass	Rosidae
Order	Apiales
Family	Apiaceae (Umbelliferae)
Genus	Coriandrum L.
Species	*Coriandrum Sativum L.*
Synonyms	Dhana, Havija, Malli, Coriander
Functionality in food	Flavor ingradient
Packaging and storage	Store in full, tight containers protected from light. Avoid exposure to excessive heat

For the highest yield of quality essential oil, harvesting should be completed when the fruits have attained ripeness [16], as evidenced by a rust red color, then dried by placing in drying lofts. The seeds are ground and used as a spice, particularly in Eastern Europe.

The fresh herbs and unripe fruit have a ‘‘bug-like” smell, while ripe fruits exhibit a pleasant tangy odor and taste [17]. The seeds are used to prepare an infusion (3 %), tincture and fluid exract [18]. Additionally, a brownish-yellow liquid oleoresin (a naturally occurring mixture of a resin and an essential oil) is produced from selected quality seed [19].

The general chemical composition present in coriander fruits are described in Table 2. Major active constituents of C*oriandrum sativum* are essential oils and fatty oil. The aromatic oil in coriander is a digestive stimulant. The oil contains linalool and other important terpenoids. Other active compounds in coriander include flavonoids, phenolic acids and mucilage (a soluble fiber). Coriander also contains a number of substances with mild anti-bacterial activity. Preliminary reports suggest that both cilantro and the coriander seeds contain dodecanal, a natural antibiotic that protects against food-borne illnesses caused by Salmonella.

ACTIVE CONSTITUTES

Table 2: Describes chemical composition of *Coriandrum Sativum* (Axel Diederichsen et al., 1996**).**

Components	**Content Percentage (%)**
Water	11.37
Crude Protein	11.49
Fat	19.15
Crude Fibre	28.43
Starch	10.53
Pentosans	10.29
Sugar	1.9
Mineral Constitutes	4.98
Essential Oil	0.84

Coriander seeds also contain phthalides and polyacetylenes. These phytochemcials, commonly found in plants belonging to the parsley family, are protective against cancer. They also contain small amounts of coumarins, substances that possess blood thinning properties. Coriander also contains antioxidant and anti-inflammatory compounds [20]. The composition of the essential oil & fatty oil are described in Table 3 and Table 4 respectively [21, 22].

Table 3: Describe composition of Essential oil in ripe Fruits of Coriandrum Sativum (Axel Diederichsen et al., 1996**).**

Main Components	**% Total Essential oil**
Linalool	60–80
Alpha-pinene	10.5
Gamma-terpinene	9.0
Geranylacetate	0.1–4.7
Camphor	0.9–4.9
Geraniol	1.2–4.6
Terpinen-4-ol	3.0
α-terpineol	0.5
γ-terpinene	1-8
Limonene	0.5-4
α –pinene	0.2-8.5
Camphene	1.4
Myrcene	0.2-2
Ketones	7-9
Linalyl acetate	0-2.7

Table 4 : Describe compostion of Fatty acid in ripe fruits of Coriander Sativum (Axel Diederichsen et al., 1996**).**

Main Components	**% of all Fatty Acids**
Petroselinic acid C18:1	68.8
Linoleic acid C18:2	16.6
Oleic acid C18:1	7.5
Palmitic acid C16:0	3.8

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

CONTAMINATION OF CORIANDER

Several investigators reported contamination of coriander and its products with mycotoxins, pesticides and other materials. Aziz and Youssef [23] reported detection of aflatoxin B1 (8 lg/kg) and G1 (2 lg/kg) in two samples of coriander. In another study, El-Kady et al. [24] reported detection of aflatoxins B1 and G1 in one sample of coriander seeds. Kaphalia et al. [25] reported detection of hexachlorohexane (0.4 ppm) and DDT (0.36 ppm) in four samples of coriander spice. Briggs and McLaughlin [26] reported a low-temperature, thinlayer chromatography method for the detection of polybutene contamination in volatile oils.

HEALTH BENEFIT OF CORIANDER

Coriander is one of the most important spices in the world and is regularly used by Indian kitchen. In addition to its 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, gripping pain and vomiting [27] and as antiedemic, Antiseptic, and emmenagogue [28]. The traditional claim for its anti diabetic has been validated in streptozotacin (STZ) diabetic mice [29] and in high fat diet rats [30]**.**

Since the umbelliferous fruit aqueous extracts exhibited antioxidant activity in in vitro and in vivo studies [31], they were evaluated for their hypoglycaemic and antihyperglycaemic activities in normal and alloxan induced diabetic rats. Coriandrum sativum is an annual herb, belonging to family Apiaceae (Umbelliferae) [32], has been reported to have a number of possible medicinal attributes including antispasmodic, carminative and stomachic properties [33]. Coriander has been advocated as an antidiabetic remedy [34]. More recent studies have confirmed the antihyperglycemic effect of Coriander in streptozotocin-diabetic mice [29], suggesting that further studies are warranted on the antihyperglycemic actions of this plants. Antidiabetic agents can exert beneficial effects in the diabetic environment by improving and/or mimicking insuln action and /or by enhancing insulin secretion [35].

Medhin et al. [36] demonstrated that aqueous extracts of coriander seeds inhibit the electrically-evoked contractions of spiral strips and tubular segments of isolated central ear artery from rabbit. In another study, Medhin et al. [37] reported that the water extract of coriander seed had hypotensive effects in rats.

The hypolipidemic activities of liponil and coriander were evident in both synthesis and excretory phase of Triton-induced hyperlipidemia in rats. Triton induces hyperlipidemia by increasing the hepatic synthesis of cholesterol [38], and triglyceride [39]. A significant decrease in cholesterol and triglyceride levels was observed in animals fed on coriander seeds [40]. So, it can be assumed that Coriander inhibits the biosynthesis of Cholesterol and triglycerides and therefore can be used for the prevention (Prophylactic) of hyperlipidemia.

In a similar study, the prophylactic property of probucol was evident as it was effective in controlling cholesterol in the synthesis phase of triton induced hypercholesterolemia [41]. In the excretory phase of triton-induced hyperlipidemia, the breakdown of lipids occurs. Coriander, like liponil was effective in excretory phase and it could be assumed that it increases the metabolism or excretion of lipids. In rats fed high cholesterol diet, Coriander reduced the lipid levels by virtue of increased bile acid synthesis and increased degradation of Cholesterol to fecal bile acids and neutral sterols [42].

Extracts of different polarity from leaves and seeds of *Coriandrum sativum* and coriander oil were investigated for their antioxidant activity. Three different bioassay were used, namely scavenging of the diphenylpicrylhydrazyl (DPPH) radical method, inhibition of 15-lipoxygenase (15-LO) and inhibition of Fe^{2+} induced porcin brain phospholipid peroxidation.

A typical coriander extract may be obtained by various processes known for making extractions from herbs, such as water or water/alcohol extraction processes, supercritical CO_2 extraction, etc. Typically such an aqueous and alcoholic extract of coriander contains linalool and glucosides, such as various β-D- glucopyranosides. Long chain (C_6-C_{10}) alcohols and aldehydes are common and it may also contain phospholipids, phytosterols, flavonoids and active phenols [43]. Such an extract can function as a primary or secondary chelator for mercury, as well as be used to prepare a primary chelator blend. Positive correlations were already found between total phenolic content in the extracts and antioxidant activity [44]. Phytonutrients, flavonoids and active phenolic acid compounds of coriander help to control blood sugar, lowers cholesterol and fights inflammation and free radicals [45].

Hypolipidemic effect of coriander seeds (*Coriandrum sativum*) were noted by Chithra and

Leelamma [42]. The increased activity of plasma LCAT, enhanced hepatic bile acid synthesis and the increased degradation of cholesterol to fecal bile acids and neutral sterols appeared to account for its hypocholesterolemic effect. In another study, Chithra and Leelamma [30] studied the changes in levels of lipid peroxides and activity of antioxidant enzymes in Sprague–Dawley female rats (n = 6) maintained on a high fat diet containing 10 % coriander seed powder for 90 days. Feeding a diet containing coriander seed powder resulted in a significant decrease in the levels of lipid peroxides as determined by malondialdehyde, hydroperoxides and conjugated dienes in liver and heart. The levels of free fatty acids in serum, liver and heart of the treated animals were significantly decreased. Antioxidant-related enzymes, such as superoxide dismutase, catalase, glutathione peroxidase, glutathione-S-transferase, glucose 6-phosphate dehydrogenase and glutathione reductase were significantly increased in the liver and heart of the treated animals. The results of this study suggest that coriander seed may protect various tissues by preventing the formation of free radicals.

Aqueous infusions and aqueous decoctions of *Coriandrum sativum* (coriander) against 186 bacterial isolates belonging to 10 different genera of G +ve bacterial population and 2 isolates of Candida albicans isolated from urine specimens. The well diffusion technique was employed. The aqueous infusion and decoction of coriander did not show any antimicrobial activity against G –ve urinary pathogens as well as against Candida albicans [46].

The antioxidative property of coriander seed is related to the large amounts of tocopherols, carotenoids and phospholipids [47], which act through different mechanisms. Carotenoids act as primary antioxidants by trapping free radicals and as secondary antioxidants by quenching singulet oxygen [48]. Tocopherols and sterols interact with oil surfaces and release hydrogen, inhibiting the propagation step of radical reactions [48]. Synergetic effects were evidenced with combinations of carotenoids and tocopherols [48, 49]. Although the exact mechanism of antioxidative action of phospholipids is not still fully established, these substances would synergistically act with tocopherols, would form barrier for O_2 between air/oil interfaces, would favour formation of Mallard like compounds with oxidation products or would chelate pro-oxidant metals with phosphate groups [49].

There is another class of bioactive substances called phthalides, which have anticarcinogenic potential. They are found in umbelliferous plants like celery, parsley, cumin, dill, fennel, and coriander. The phthalides are known to increase the glutathione-S-transferase level [50]. This could thus be attributed to the possibility that coriander might provide some recovery in GSH level.

Coriander extracts administration reduced concentrations of SGOT and SGPT which might be probably due to presence of flavonoids in the extract. It is well documented that flavonoids and glycosides are strong antioxidants [51].

In vitro anthelmintic activities of crude aqueous and hydro-alcoholic extracts of the seeds of *Coriandrum Sativum* were investigated on the egg and adult nematode parasite Haemonchus contortus. The aqueous extract of *Coriandrum Sativum* was also investigated for in vivo anthelmintic activity in sheep infected with Haemonchus contortus. Both extract types of *Coriandrum Sativum* inhibited hatching of eggs completely at a concentration less than 0.5 mg/ml. ED(50) of aqueous extract of *Coriandrum Sativum* was 0.12 mg/ml while that of hydro-alcoholic extract was 0.18 mg/ml [52].

The juice of fresh leaves and the tea of powdered fruits of coriander are recommended for relief of anxiety and insomnia in Iranian traditional medicine. Similar uses of coriander, i.e. as a sedative or for relief of nervousness, have also been indicated in other folk medicine [53]. However, its central depressant effects have not been evaluated in scientific studies. Researchers have recently demonstrated that the aqueous extract of coriander seeds decreased general locomotor activity in mice [54]. A decrease in

spontaneous activity indicates that coriander seeds may have a sedative effect [54].

Although coriander was widely described as a chelator of lead, mercury or other heavy metals in internet literature, and is often used as such, the claims are seemingly based on a paucity of research and no traditional use. Coriandrum sativum suppresses the deposition of lead by chelating the metal [55]. A sorbent prepared from coriander was found to have good efficiency in removing organic and methyl mercury from aqueous solutions [56]. It has also been speculated that coriander may enhance the excretion of heavy metals in the urine of patients with various infections and augments the efficacy of antibiotics [57, 58]. Phitic acid (PA), a major phosphorus storage compound in most seeds and cereal grains, is known as a natural chelating agent [59]. PA has strong ability to chelate multivalent metal ions [59]. The binding of metals with PA can result in the formation of very water insoluble salts that are poorly absorbed from gastro intestinal tract and results in poor bioavailability [59]. It is possible that Coriander may contain similar type of chelating agents. Lead content found in different tissues after Coriandrum sativum administration was decreased to some extent in present study was almost similar to findings of some researcher. The MeOH extract of Chinese parsley also reduced lead induced inhibition of delta aminolevulinic acid dehydratase (Phosphobilinogen synthase) activity In vitro [55].

CONCLUSION

Numerous phytochemical and pharmacological studies have been conducted on different parts of Coriander Sativum. The present literature supports the potential of Coriander sativum as a medicinal hierarchy. Coriander and its oil have a long history of dietary use, with no record of harm caused by consumption of these ingredients. Moreover, addition of Coriander to food will increase the antioxidant content and may have potential as a natural antioxidant and thus inhibit unwanted Oxidation processes. In view of the nature of the plant, more research can be done to investigate the unexplored and unexploited potential of this plant.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

ACKNOWLEDGEMENTS

The authors are thankful to the authorities of Banasthali University for providing support to the study.

Figure1: Coriandrum sativum in its flowering stage

Figure 2: Leaves of Coriandrum sativum

Figure 3: Fruits of Coriandrum sativum

REFERENCES

1. Manniche L. An ancient Egyptian Herbal. University of Texas Press, Austin. 1989; P. 94.
2. Gööck R. Das Buch der Gewürze. Mosaik Verlag, München. 1977; pp. 116-117.
3. Cicin N.V. (ed.). Atlas lekarstvennych rastenij SSSR. Gosudarstvennoe izdatel'stvo medicinskoj literatury, Moskva. 1962; pp. 250-251.

4. Uhl, S.R. Coriander. Handbook of Spices, Seasonings, and Flavorings. Technomic Publishing Co., Inc., Lancaster, PA. 2000; pp. 94–97.
5. Grieve M. Coriander. A Modern Herbal: The Medicinal, Culinary, Cosmetic and Economic Properties, Cultivation and Folk-Lore, vol. 1. Dover Publications, New York, NY.1971; pp. 221–222.
6. Livarda A. and Van der Veen, M. Social access and dispersal of condiments in North–West Europe from the Roman to the medevil period. Vegetation History and Archeobotany 2008; 5: 1–9.
7. Reus W.A. The medieval childbirth painting of the Codex vindobonensis 93, fol. 102r, illustrating a magic prescription of herba coriandri, in the Austrian national library. Gynakol Geburtshilfliche Rundsch. 1996; 36: 92–100 (in German)
8. Kiple K.F. and Ornelas, K.C. Coriander. The Cambridge World History of Food. Cambridge University Press, New York, NY.2000; p. 1762.
9. Opdyke D.L.J. Monographs on fragrance raw materials. Coriander oil. Food and Cosmetics Toxicol. 1973; 11: 1077.
10. Vaidya V.M. Gogt. Ayurvedic Pharmacology & Therapeutic uses of medicinal plants. Dravyagunavigyan press, First edition, Mumbai, India, 2000; 405-406.
11. Uchibayashi M. The coriander story. Yakushigaku Zasshi. 2000; 36: 56–57 (in Japanese).
12. Blumenthal M. Coriander seed. In: Blumenthal, M., Goldberg, A., Brinckmann, J., Foster, S. (Eds.), Herbal Medicine: Expanded Commission E Monographs. Integrative Medicine Communications, Newton, MA, 2000; pp. 75–77.
13. Grieve M. A modern herbal: coriander. <http://www.botanical.com/ bothanical/mgmh/c/corian99.html> (site visited on 8/22/2003), 2003.
14. ADAS. Culinary and medicinal herbs. HMSO. 2002.
15. Small E. Coriander. Culinary Herbs. NRC Research Press, Ottawa, Canada. 1997.
16. Tsvetkov R. Study on the fruit quality of some unbelliferous essential oil plants. Planta Medica. 1970; 18: 350–353.
17. PDR. Coriandrum sativum (Coriander), first ed.. Physician's Desk Reference (PDR) for Herbal Medicines Medical Economics Company, Montvale, NJ. 1998; pp.775–776.
18. Burdock G.A. Coriander oil, fourth ed.. Fenaroli's Handbook of Flavor Ingredients CRC Press, Boca Raton, FL. 2002a; pp. 344–345.
19. Arctander S. Coriander oil. Perfume and Flavor Materials of Natural Origin, Elizabeth, NJ. 1960; pp. 191–193.
20. Craig W. Coriander: For Digestive Complaints. Vegetarianism and Vegetarian Nutrition. 2008.
21. Axel Diederichsen . Promoting the conservation and use of underutilized and neglected crops : Coriander (Coriandrum sativum L). 1st edition, International Plant Genetic Resources Institute IPGRI, Itly. 1996.
22. The Indian herbal pharmacopeia. Revised edition, published by Indian drug manufacturer association, Mumbai, India. 2002; 144-152.
23. Aziz N.H. and Youssef, Y.A. Occurrence of aflatoxins and aflatoxin-producing moulds in fresh and processed meat in Egypt. Food Additives and Contaminants. 1991; 8: 321–331.
24. El-Kady I.A., El-Maraghy S.S. and Eman Mostafa M. Natural occurrence of mycotoxins in different spices in Egypt. Folia Microbiologica. 1995; 40: 297–300.
25. Kaphalia B.S., Takroo R., Mehrotra S., Nigam U. and Seth T.D. Organochlorine pesticide residues in different Indian cereals, pulses, spices, vegetables, fruits, milk, butter, deshi ghee, and edible oils. Journal of the Association of Official Analytical Chemists. 1990; 73: 509–512.
26. Briggs C.J. and McLaughlin L.D. Low-temperature thin-layer chromatography for detection of polybutene contamination in volatile oils. Journal of Chromatography. 1975; 101: 403–407.
27. Usmanghani K., Saeed A. and Alam M.T.indusyunic medicine. Traditional medicine

herbal, animal, mineral origin in Pakistan. (B.C.C and T. press, University of Karachi). 2003; 184.

28. Duke J.A., Bogenschutz Godwin M.J., Du Celliar J. and Duke P.A.K. In handbook of medicinal herbs Second ed. (CRC Press Boca Raton). 2002; 222.
29. Swanstson Flatt S.K., Day C., Bailey C.J. and Flatt P.R. Traditional plant treatment for diabetes. Studies in normal and Streptozotocin diabetic mice. Diabetologia. 1990; 33: 462.
30. Chithra V. and Leelamma S. Coriandrum sativum changes the levels of lipid peroxides and activity of antioxidant enzymes in experimental animals. Ind. J. Biochem. Biophys. 1999; 36: 59-61.
31. Satyanarayana S., Sushruta K., Sharma G.S., Srinivas N. And Subba Raju G.V. Antioxidant activity of the aqueous extracts of spicy food additives – evaluation and comparison with ascorbic acid in in-vitro systems. J Herb Pharmacother. 2004; (2):1-10.
32. Blumenthal M. Coriander seed. In: Blumenthal, M., Goldberg, A., Brinckmann J., Foster, S. (Eds.), Herbal Medicine: Expanded Commission E Monographs. Integrative Medicine Communications, Newton, MA. 2000; pp. 75–77.
33. Lust J. The Herb Book. London. 1986; Bantam Books.
34. Lewis W.H. and Elvin- Lewis M.P.F. Medical Botany: Plants Affecting Man's Health. New York. 1977; NY: Wiley.
35. Gray A.M. and Flatt P.R. Insulin-releasing and insulin-like activity of the traditional anti-diebetic plant Coriandrum sativum (coriander). Br J Nutr. 1999; 81:203-9.
36. Medhin D.G. and Bakos P. Hadhazy P. Inhibitory effects of extracts of Lupinus termis and Coriandrum sativum on electrically induced contraction of the rabbit ear artery. Acta Pharmaceutica Hungarica. 1986a; 56:109–113.
37. Medhin D.G., Hadhazy P., Bakos P. and Verzar-Petri G. Hypotensive effects of Lupinus termis and Coriandrum sativum in anesthetized rats: preliminary study. Acta Pharmaceutica Hungarica. 1986b; 56:59–63.
38. Vogel H.G. and Vogal W.H. Drug discovery and evaluation. Pharmacological assays. 1997; 598.
39. Akiba Y., Kimura S., Satoh K. and Horiguchi M. Mild hyperlipidemia induced by Triton WR-1339, a non-ionic detergent, in chicks. Anim Sci Technol. 1992; 63:785.
40. Dhanapakiam1 P., Joseph J.M., Ramaswamy V.K., Moorthi M. and Senthil Kumar A. The cholesterol lowering property of coriander seeds (Coriandrum sativum): Mechanism of action. Journal of Environmental Biology. 2008; 29(1): 53-56.
41. Kriahnamurthy A., Thapar G.S. and Shridhar D.R. Effect of probucol on triton induced hyperlipidemias in CFY rats. Artery. 1985; 13:87.
42. Chithra V. and Leelamma S. Hypolipidemic effect of coriander seeds (Coriandrum sativum): mechanism of action. Plant Foods Hum. 1997; 51:167-72.
43. Henry DC, Neil RS, William JS. Dietary supplement for promoting removal of heavy metals from the body. 2003; Available from: www.freepatentsonline.com/y2003/0194453.html.
44. Helle Wangensteen, Anne Berit Samuelsen, Karl Egil Malterud. Antioxidant activity in extracts from coriander. Food Chem. 2004; 88:293-297.
45. Drumweaver. Coriander chelates heavy metals and toxins from your body. 2009; Available from hubpages.com/hub/cilantro-chelates.
46. Sabahat saeed perween tariq: antimicrobial activities of emblica officinalis and coriandrum sativum against gram positive bacteria and candida albicans pak. J. Bot. 2007; 39(3): 913-917.
47. Ramadan M.F. and Morsel J.T. Oil goldenberry (Physalis peruviana L.). J Agric. Food Chem. 2004; 51: 969−974.
48. Reische D.W., Lillard D.A. and Eitenmiller R.R. Antioxidants in: Food lipids, second edition. Eds. Akoh CC, Min DB, Marcel Dekker NY (USA). 2002; 489-516.
49. Haila K.M., Lievonon S.M. and Heinonen M.I. Effects of lutein, lycopene, annatto, and γ-tocopherol on autoxidation of triglycerides. J. Agric. Food Chem. 1996; 44: 20096-2100.

50. Wildman R.E.C. Handbook of Nutraceuticals and Functional Foods. London, New York, Washington D.C.: CRC Press, 2000; p. 16.

51. Kavithalakhsmi N., Narasimhan M., Shanmugasundaram K.R. and Shanmugasundaram E.R.B. Antioxidant activity of a salt spice herbal mixture against free radical induction. J Ethnopharmacol. 2006; 105(1–2): 76–83.

52. Pathak Nimish L., Kasture Sanjay B., Bhatt Nayna M. and Rathod Jaimik D. Phytopharmacological Properties of Coriander Sativum as a Potential Medicinal Tree: An Overview Journal of Applied Pharmaceutical Science. 2011; 01(04): 20-25

53. Duke J.A. Handbook of Medicinal herbs/James A. Duke, with Bogenschutz-Godwin M, duCellier J, Duke PK. 2nd ed. CRC press LLC, Boca Raton, Florida; USA. 2002; p. 222-3.

54. Emamghoreishi M., Khasaki M. and Fath-Aazam M. Coriandrum sativum: Evaluation of its anxiolytic effect in the elevated plus-maze. J Ethnopharmacol. 2005; 96:365-70.

55. Aga M., Iwaki K., Ueda Y., Ushio S., Masaki N., Fukuda S., Kimoto T., Ikeda M. and Kurimoto M. Preventive effect of Coriandrum sativum (Chinese parsley) on localized lead deposition in ICR mice. J Ethnopharmacol. 2001; 3(2–3):203–208

56. Karunasagar D., Krishna M.V., Rao S.V. and Arunachalam J. Removal and preconcentration of inorganic and methyl mercury from aqueous media using a sorbent prepared from the plant Coriandrum sativum. J Hazard Mater. 2005; 118(1–3): 133–139.

57. Omura Y. and Beckman S.L. Role of mercury in resistant infections and effective treatment of Chlamydia trachomatis and Herpes family viral infections (and potential treatment for cancer) by removing localized mercury deposits with Chinese parsley and delivering effective antibiotics using various drug uptake enhancement methods. Acupunct Electrother Res. 1995; 20: 195–229.

58. Omura Y., Shimotsuura Y., Fukuoka A., Fukuoka H. and Nomoto T. Significant mercury deposits in internal organs following the removal of dental amalgam, and development of pre cancer on the gingival and the sides of the tongue and their represented organs as a result of inadvertent exposure to strong curing light (used to solidify synthetic dental filling material) of effective treatment: a clinical case report, along with organ representation areas for each tooth. Acupunct Electrother Res. 1996; 21:133–160

59. Zhou J.R. and Jr. Erdman J.W. Phitic acid in health and disease. Crit Rev Food Sci Nutr. 1995; 35: 495–508.

*****