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Rakesh Kumar Joshi

Lecturer Chemistry,
Department of Education,
Government of Uttarakhand,
India

Rachid Soulimani

Université de Lorraine,
LCOMS/ Neurotoxicologie
Alimentaire ET Bioactivité,
Campus Bridoux, Metz, France

Ethno-medicinal and phytochemical potential of *Carum carvi* Linn. and *Cuminum cyminum*: A review

Rakesh Kumar Joshi, Rachid Soulimani

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Abstract

Caraway (*Carum carvi* L.) is a biennial plant in the family Apiaceae. Its seeds (fruits) which are used in food, cosmetics, beverage and pharmaceutical industries. Processed products from caraway whole seed, such as seed powder, essential oil, fatty oil, oleoresins and caraway carvone are widely used in the food and medicinal industries. Caraway is one of the earliest cultivated herbs in Asia, Europe and Africa. The caraway seeds are considered as antispasmodic, carminative, astringent and used in the treatment of stomach stimulant, diarrhea, dyspepsia, hysteria, flatulent indigestion, colic, dyspeptic headache and improve liver function. In ancient Indian ayurvedic literature use of *C. carvi* seeds is well documented. Scientist working in different parts of the world has now experimentally proved the validity of ancient therapeutic uses of *C. carvi* seeds. This will strengthen our use of caraway seeds in traditional system of ayurvedic treatments by *C. carvi* seeds.

Keywords: Caraway, bioactivity, antioxidant activity, limonene

1. Introduction

MPs play a vital role in the development of new drugs and the forests of India have been a source of traditional medicines for millennia. Of the 17,000 species of higher plants described in India, 7500 are known for their medicinal uses [1-3]. The Charak Samhita, a document on herbal therapy written about 300 BC, reports on the production of 340 herbal drugs and their indigenous uses [4]. The Indian Himalayan Region is well known to have a great range of plant diversity. The state of Uttarakhand is a part of north-western Himalaya, and still maintains a dense vegetation cover (65%). The maximum species of medicinal plants have been reported from Uttarakhand [5-6]. This region alone supports about 18,440 plant species (Angiosperm: 8,000 spp., Gymnosperm: 44 spp., Pteridophytes: 600 spp., Bryophytes: 1,736. Lichens: 1,159 spp. and fungi: 6,900 spp [7]. According to Samant *et al.* out of the total vascular plant species, 1,748 species are of medicinal uses [8]. Cumin (*Cuminum cyminum*) and Caraway (*Carum carvi* L.), from the; Umbelliferae; Apiaceae family, is one of the common well-known herbs, naturally found in Europe, West Asia, Siberia, Turkey, Iran, India and North Africa. In India, now cultivated in Bihar, Orissa, Punjab, Bengal, Andhra Pradesh and hills of Kumaon and Garhwal, Chamba and Kashmir. Also found in the North Himalayan regions. It is known as Caraway in English, Krishna jiraka in Ayurved. It is used as Carminatives, antispasmodic, antimicrobial etc. Its seed oil is used in dyspeptic problems, such as mild, spastic conditions of gastrointestinal tract. The seed oil contains a volatile oil consisting of carvone and limonene with other constituents; flavonoids mainly quercetin derivatives as a fixed oil [9]. In our previously published research and review articles we have published about essential oil, biological and medicinal values of some Himalayan medicinal plants [10-22]. The search for the chemical compositions and pharmacological activities exhibited by the isolated bioactive constituents and/or by the crude extracts was carried out using various searches.

2. Ethno-medicinal uses

In Indian therapeutic system a large number of medicinal herbs of various taxonomic genera are included in many forms in this traditional therapy. Literature survey revealed that cumin as well as caraway seeds are prominently considered carminative, eupptic, antispasmodic, astringent and used in the treatment of mild digestive disorders, diarrhea, dyspepsia,

Corresponding Author:

Rakesh Kumar Joshi

Lecturer Chemistry,
Department of Education,
Government of Uttarakhand,
India

Flatulence, morning sickness, colic, dyspeptic headache and bloating, and are said to promote the assimilation of other herbs and to improve liver function [23-24]. Essential oils from caraway seeds are reported to give relief in patients suffering from lumbago and rheumatism [25]. Caraway water finds use as a vehicle for pediatric medicines. As a mixture with alcohol and castor oil, it has been used for the treatment of scabies [26]. In fact, medicinal usage of cumin and caraway seeds has also been immensely widespread in diverse ethno-medicinal systems from Northern Europe to the Mediterranean regions, Russia, Iran, Indonesia and North America, where these have remained as an integral part of their folk medicines. In Iranian traditional medicine, cumin is considered stimulant, carminative and astringent and its therapeutic effects have been described on gastrointestinal, gynecological and respiratory disorders, and also for the treatment of toothache, diarrhea and epilepsy [27]. In the Moroccan traditional medicine, caraway seeds are used as diuretics [28] and given to treat diabetes and hypertension [29].

In traditional medicine of Tunisia, cumin is considered abortive, galactagogue, antiseptic, antihypertensive herb,

while in Italy, it is used as bitter tonic, carminative, and purgative [30]. In indigenous Arabic medicines, the seeds are documented as stimulant, carminative, and attributed with cooling affect and therefore form an ingredient of most prescriptions for gonorrhea, chronic diarrhea and dyspepsia; externally, they are applied in the form of poultice to allay pain and irritation of worms in the abdomen. Seeds reduced to powder, mixed with honey, salt and butter are applied to scorpion bites [31]. In Poland, caraway is recommended as a remedy to cure indigestion, flatulence, lack of appetite, and as a galactagogue. In Russia, it is also used to treat pneumonia. In Great Britain and USA, it is regarded a stomachic and carminative. In Malay Peninsula, caraway is one important medicinal herb, and in Indonesia, it is used in the treatment of inflamed eczema [32].

3. Biological activities

Literature survey revealed that Cumin (*Cuminum cyminum*) and Caraway (*Carum carvi* L.) products (oils as well as their aqueous and solvent derived extracts) have shown significant number of biological activities in many ways. A summary of all those given in table.

Table 1: Biological activities

Type of Bioactivity	Descriptions about activity	References
Antioxidant activity	Essential oils and extract of different parts of cumin (<i>Cuminum cyminum</i>) have shown significant antioxidant activity in several test methods, as quench hydroxyl radicals, 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radicals and lipid peroxides. The other assays employed were ferric thiocyanate method in linoleic acid system, Fe ²⁺ ascorbate-induced rat liver microsomal lipid peroxidation (LPO), soybean lipoxygenase dependent lipid peroxidation and ferric reducing ability. Caraway (<i>Carum carvi</i> L.) root extract has also shown significant anti-DPPH radical activity.	[33-37]
Antimicrobial activity	Investigations revealed that antimicrobial activity of cumin (<i>Cuminum cyminum</i>) and caraway (<i>Carum carvi</i> L.) products (essential oils as well as their aqueous and solvent derived extracts). This antibacterial action was assessed against a range of useful and pathogenic gram-positive and gram-negative bacterial strains. Cumin seed oil and alcoholic extract inhibited the growth of <i>Klebsiella pneumoniae</i> and its clinical isolates and caused improvement in cell morphology, capsule expression and decreased urease activity. This property was attributed to cuminaldehyde biofilm-formation preventive properties were found against <i>Streptococcus mutans</i> and <i>Streptococcus pyogenes</i> .	[38-48]
Antidiabetic activity	A methanolic extract of cumin (<i>Cuminum cyminum</i>) seeds reduced the blood glucose and inhibited glycosylated hemoglobin, creatinine, blood urea nitrogen and improved serum insulin and glycogen (liver and skeletal muscle) content in alloxan and streptozotocin (STZ) diabetic rats [49-50]. The anti-diabetic effects of cumin (<i>Cuminum cyminum</i>) and caraway (<i>Carum carvi</i> L.) products are amply documented [51]. In a glucose tolerance test conducted in rabbits, cumin significantly increased the area under the glucose tolerance curve and hyperglycemic peak [52]. In another study, an aqueous extract of cumin (<i>Cuminum cyminum</i>) prevented <i>in vitro</i> glycation of total soluble protein, α -crystallin, and delayed the progression and maturation of STZ-induced cataract in rats. Cumin prevented loss of chaperone activity in diabetic rats and also attenuated the structural changes of α -crystallin in lens, which is a long-lived protein and is susceptible to several post-translational modifications in certain diabetic conditions [53]. Caraway oil (<i>Carum carvi</i> L.) exhibited anti-hyperglycemic activity in alloxan-induced diabetic rats and increased the body weight [54]. The biologically active constituent of cumin seed oil was characterized as cuminaldehyde which inhibited aldose reductase and α -glucosidase isolated from rat [55]. Cumin suppressed alcohol and thermally oxidized oil induced hyperlipidemia. It decreased aspartate transaminase (AST), alkaline phosphatase (ALP) and γ -glutamyl transferase (GGT) activities and decreased the tissue (liver and kidney) levels of cholesterol, triglycerides and phospholipids and prevented the changes in the composition of fatty acids in the plasma of rats administered with alcohol and/or thermally oxidized oil. The activity of phospholipase A and C decreased significantly [56-57]. Hypocholesterolemic effect of methanolic extract of cumin is also documented in ovariectomized rat in relation to its anti-osteoporotic effect [58]. Aqueous extract of caraway showed potent lipid lowering activity (hypotriglyceridemic and hypocholesterolemic) in both normal and STZ-diabetic rats after single and repeated oral administration [59]. Cumin (<i>Cuminum cyminum</i>) added to a hypercholesterolemia diet decreased serum and liver cholesterol in rats [60].	[49-60]
Diuretic activity	The traditional use of caraway as a diuretic was confirmed in an experimental study in which peroral treatment of an aqueous extract of caraway (in acute and sub-chronic mode) was shown to increase the urine output during and after 24 hours in rat. The urinary levels of sodium and potassium were found to be increased, while in plasma these were not affected. Carum (<i>Carum carvi</i> L.) extract did not produce any renal toxicity or any other adverse effects during the study period [61].	[61]
Gastrointestinal activity	In human trial studies, some herbal preparations consisting predominantly caraway (<i>Carum carvi</i> L.) have shown efficacy in relieving dyspeptic symptoms [62]. The antispasmodic effect of an alcoholic extract of caraway has shown inhibitory effects on smooth muscle contractions induced by the spasmogens, acetylcholine	[62-66]

	and histamine ^[63-64] . Extracts from caraway produced dose-dependent antiulcerogenic effect against indomethacin-induced gastric ulcers, accompanied by reduction in acid and leukotrienes' output, and increased mucin secretion and prostaglandin E2 release. The antiulcerogenic activity was also confirmed histologically and was attributed to its flavonoid content and free radical scavenging properties ^[65] . Aqueous and solvent derived extracts of cumin (<i>Cuminum cyminum</i>) increased amylase, protease, lipase and phytase activities ^[66] .	
CNS activity	Anti-epileptic activity of fruit essential oil of (<i>Cuminum cyminum</i>) is documented. It decreased the frequency of spontaneous activity induced by pentylenetetrazol (PTZ). This protection was measured in a time- and concentration-dependent manner as increased duration, decreased amplitude of hyperpolarization potential, the peak and firing rate of action potential and excitability of nerve cells ^[67] . Cumin oil was found to attenuate seizures induced by maximal electroshock and PTZ in mice ^[68] . Cumin oil has also been found to possess significant analgesic action in a chemical model (formalin test) of nociception in rat ^[69] .	[67-69]
Immunomodulatory activity	In a recent study, oral treatment with cumin showed immunomodulatory properties in normal and immune-suppressed animals via modulation of T lymphocytes' expression in a dose-dependent manner. It stimulated the T cells' (CD4 and CD8) and Th1 cytokines' expression in normal and cyclosporine-A induced immune-suppressed mice. In restraint stress-induced immune-suppressed animals, the active compound of cumin countered the depleted T lymphocytes, decreased the elevated corticosterone levels and size of adrenal glands and increased the weight of thymus and spleen ^[70] .	[70]

4. Chemical composition:

Caraway (*Carum carvi* L.) seeds contain several components; major phytochemicals of *C. carvi* essential oil were 37.98% (R)-carvone, 26.55% D-limonene, 5.21% α -pinene, 5.01% cis-carveol and 4.67% β -myrcene ^[71]. The essential oil of *C. carvi* was also characterized by high contents of oxygenated monoterpenes (62.17%), monoterpenes (36.08%) and sesqui terpenes (0.41%), saturated and unsaturated fatty acids, ketones, aldehydes and esters ^[72-73]. Earlier reports showed that this plant contain a variety of secondary metabolites such as mono and sesquiterpenoids ^[74], steroids and coumarins ^[75], flavonoids ^[76], aromatics and their glucosides, alkaloids and aliphatic compounds ^[75]. High proportion of sesquiterpene hydrocarbons, limonene, γ -cadinene, β -selinene and β -elemene were observed in GC/MS analyzed flower volatiles of *C. carvi* seeds ^[74]. Kunzemann *et al.* ^[77].

5. Conclusions

Carum carvi L. seeds are rich sources of essential oils containing diverse group of phytochemicals. It has abroad spectrum pharmacological effect in treatment of traditional healing systems in different parts of the world. In last two decades extensive studies has been carried on *Carum carvi* L. seeds to explore its full potential of pharmacological action. A natural product used in conventional treatment provides a clue for the existence of phytochemicals. New researches on caraway proved it as a source of new entities to perform different pharmacodynamic properties, responsible for their pharmacological effects. The present review is a step to promote it for cultivation in large scale in Uttarakhand for improvement of economy of peoples living in hill areas.

Transparency Declaration

The authors declare no conflicts of interest.

Author's Contributions

All authors are involved in drafting the manuscript, read and approved the final version of the manuscript.

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