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PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF *CARUM CARVI*

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ABSTRACT

Carum carvi, Linn (Zeera Siyah) is one of the earliest cultivated herbs in Asia, Africa and Europe. It is an annual or biennial glabrous herb, 30-100 cm in height with narrow tip cylindrical fruits. The fruits have an aromatic, warm and sharp taste with a characteristic odour and they have been used since ancient era to treat digestive disorders. The seeds are widely used as spice for flavoring and seasoning foods like bread, pickles, sauces and salads because of its pungent and anise like flavor and aroma. Medicinal use of caraway fruit has been widespread in several ethno medical systems. It has shown diverse biological and pharmacologic activities. it has been used in Unani medicine (*Tibb-e-Unani*) and other traditional system of medicine from time immemorial. Keeping in view the medicinal importance of the drug in Unani Medicine, an attempt has been made to review the available literature on traditional uses and pharmacological properties of the plant.

KEY WORDS: *Carum carvi*, Caravy, Zeera Siyah.

INTRODUCTION

Caraway (*Carum carvi*, Linn) seed is a mature, dried schizocarpic fruit of a biennial herb (Rajamanickam *et al*, 2013). The plant belongs to the family Umbelliferae as it has umbrella shaped flower head (Pooja & Singh, 2014). The caraway seeds have an aromatic, warm and sharp taste with a characteristic odour and they have been used since ancient era to treat digestive disorders. Because of low water content caraway seeds are affected by humidity and temperature conditions where it is stored. The seeds are widely used as spice for flavoring and seasoning foods like bread, pickles, sauces and salads because of its pungent and anise like flavor and aroma (Rajamanickam *et al*, 2013). They are also used as flavorant in ice cream, candy, meat cheese, condiments, soft drinks, alcoholic beverages and used in liqueurs, mouthwashes, toothpaste, soaps, perfumes and cosmetics. The fined chopped leaves are used in the preparation of soups, and seeds in bakery and confectionary industry (Pooja & Singh, 2014). Total quantity of wild caraway collected annually hardly exceeds twelve tones (Anonymous, 1992). Medicinal use of caraway fruit has been widespread in several ethno medical systems from Northern Europe to the Mediterranean regions, Russia, Iran, India, Indonesia and North America (Anonymous, 2015).

Description: It is an annual or biennial glabrous herb, 30- 100 cm in height (Anonymous, 1992) with dorsally compressed seeds, cylindrical fruits with narrow tips (Chatterjee & Parkashi, 1995). Stem is erect, branched and 35-60 cm in height (Kirtikar & Basu, 1991). It has soft fern like 2- 3 leaves (Pooja & Singh, 2014) with partite at 3 sides (Chatterjee & Parkashi, 1995). They have long sheathing footstalk, once or twice pinnate, with short linear lobes and several pairs of sessile segments (Kirtikar & Basu, 1991). Fine yellow colour oil is extracted from caraway. The odour and taste of oil is same as that of caraway seed (Najmul Ghani, 2011).

Caraway has 5 mm long carpel commonly called as caraway seeds, linear oblong. They are usually curved, with the prominent ribs. Calyx is unequal, having small teeth, subulate. It has oblong or obovate, emarginated, frequently unequal, white colored petals (Chatterjee & Parkashi, 1995). Flowers are white, pink or red in color (Pooja & Singh, 2014) with compound umbels, bracteates and bracts linear, rigid in nature (Chatterjee & Parkashi, 1995).

Distribution: The plant, *Carum carvi* occurs wild in India to a limited extend in the temperate regions of the western Himalayas in Kinnaur and Chamba districts of Himachal Pradesh; in the Ladakh region of Jammu and Kashmir and in Chakrata hills of Uttar Pradesh (Anonymous, 1992). It is cultivated in the hills and plains of North India and in the hills of South India for its aromatic seeds (Anonymous, 1992). In old era Arabic physician imported the caraway from Kerman the Iranian city, so it is called as Zeera Kermani (Ansari, 2009). It is

one of the earliest cultivated herbs in Asia, Africa and Europe (Anonymous, 2015).

Vernaculars: The plant is known by different vernacular names in different language, areas and traditions: *Carawya, Kardiah, karoya* (Arabic); *Caraway, Krishna Jiraka, Krishna jirra, Sugandh, Udgaar, Shodhan* (Ayurved); *Jira* (Bengal); *Vilayat zirah* (Bombay); *Kornmen* (Danish); *Karwij* (Dutch); Caraway, Common Caraway (English); *Anis des Vosges, Carobin, Carvi, Cumin armenien, Cumin de montagne, Cumin des pres, Cumin romain* (French); *Feldkuemmel, Fishkuemmel, Gemeiner Kuemmel, Makenn, Makinisch, Mattenkammi, Mattenkuemmel, Wegkuemmlich, Wiesen Kuemmel* (German); *Shajiru, Shahjiru* (Gujrati); *Shiajira, zira, Kala zira* (Hindi); *Caro, Carvi, Comino, Comino dei prati, Comino Tedesco, Cumino dei prati, Cumino Tedesco* (Italian); *Gunyan* (Kashmir); *Umbu* (Ladak); *Shahajire* (Marathi); *Karuya* (Morocco); *Zira* (North - Western Provinces); *Karve* (Norway); *Jirah rumi, Karoya* (Persian); *Alcaravia, Alcarovia, Alchirivia, Chirivia* (Portuguese); *Zirasiyah* (Punjab); *Chimion de camp, Chimien, chinisor, Secarea, Secarica* (Roumanian); *Timon* (Russian); *Bahugandha, Bhedanika, Bhedini, Hridya, Jarana, Kalajiraka, Kalameshi, Kashmirajiraka, Krishna, Krishnajaji, Krishnajiraka, Nila, Nilakana, Patu, Ruchya, Sugandha, Sushavi, Udgarashodhini, Vantishodhini, Varshakali* (Sanskrit); *Alcaravea, Carvi, Cominos de prado* (Spanish); *Kummin* (Swedish); *Kekkuvirai, Simaishembu, Shimai shombu, Cheerakum, Jeerakam* (Tamil); *Shimaisapu, Jeelakara, Jiraka* (Telgu); *Shahjirah* (Urdu) (Anonymous, 1992; Khare, 2004; Kirtikar & Basu, 1991; Nadkarni, 1954).

***Mizaj* (Temperament)**: Some Unani physicians described the temperament of *Zeera Siyah* as Hot in second and Dry in third degree (Nadkarni, 1954; Khan, YNM). While the others categorized it as Hot and Dry in third degree (Najmul Ghani, 2011).

***Afa'al* (Action):** In classical Unani literature, various actions of *Zeera Siyah* (*Carum carvi*) have been described in details such as Mulattif, Muqatte, Muhallil, Qabiz, Muqawwi Meda wa Ama'a wa Jigar wa Gurda, Dafe Aarog wa Fuwaq, Dafe Warm-e-Tihal, Dafe Ishal, Muhallil-e-Awram, Mudirr-e-Bol wa Haiz (Khan, YNM); Hazim, Kasir Riyah, Mufriz-e-Sheer (Ali, 1993); Dafe Balgham, Dafe Ratubate Meda, Mushtahi (Najmul Ghani, 2011); Muqawwi Riya (Ibn Baitar, 2003).

***Istemal* (Uses)**
Zeera siyah is therapeutically used in various diseases such as Sue Hazam, Nafakh-e-Shikam, Dard-e-Shikam, Ihtebas-e-Haiz, Usr-e-Haiz, Qillate Laban (Ali, 1993); Taqteer-e-Bol, Ratubat-e-Meda, Zof-e-Gurda wa Jigar wa Ama'a, Zof-e-Basr (Najmul Ghani, 2011); Warm-e-Khusiya, Rua'af (nakseer), Sailan-ur-Rahem, Tanaffus-e-Intesabi, Ishal, Kasrat-e-Haiz, Kasrat-e-Lua'ab-e-Dahan (Ibn Baitar, 2003).

In pediatrics, caraway water is used in flatulence and gas trouble (Ali, 1993). Inhalation of caraway powder with vinegar relieves epistaxis (Ibn Baitar, 2003) and reduces the habit of soil eating (Khan, YNM). Local application of caraway seed paste along with olive oil or *baqla* flour cures orchitis, useful in *sailan-ur-rahem* (Ibn Baitar, 2003), tightening of breast and protruded painful haemorroidal warts (Najmul Ghani, 2011). On oral administration caraway kills all types of intestinal worms. It also relieves abdominal pain & discomfort and intestinal cramps; reduces excessive sweating, increases semen production and appetite (Najmul Ghani, 2011). Decoction prepared with the help of caraway seed helps to cure gastric and enteric inflammations; useful in fever caused by gastric troubles (Lubhaya, 2004) and relieves toothache (Khan, YNM). The decoction used as sitz bath relieves uterine pain and inflammations (Lubhaya, 2004).

***Muzir* (Adverse effect)**
Carum carvi has adverse effect on lungs, intestine and causes yellow colour hyper pigmentation of skin (Najmul Ghani, 2011). It can produce harmful effect on persons having hot temperament (Ibn Baitar, 2003).

***Musleh* (Corrective)**
Kateera is being used as corrective for adverse effect of Zeera Siyah. Vinegar is also used as corrective for hyperpigmentation of skin. While Kalonji seeds are used as Mohallil-e-Riyah (Najmul Ghani, 2011).

Pharmacological Actions
(As described in Ethnobotanical and traditional literature): The drug *Carum carvi* is described in detail in ethnobotanical literature and various actions have been reported to possess by it. Some pharmacological actions and therapeutic uses are as follows.

The fruits of the plant act as antidiarrhoeal, antidysentric, aromatic, astringent, carminative, cooling, galactogogue, diuretic, stimulant, stomachic (Chatterjee & Parkashi, 1995). They are also used to liquefy matter, athelmintic (Nadkarni, 1954), antiperiodic (Kirtikar & Basu, 1991), emmenagogue (Khare, 2004). The fruit and essential oil of caraway is antispasmodic, antibacterial in action (Khare, 2004). According to Unani system of medicine caraway seeds are cooling to the brain, astringent to bowel, expectorant, pectoral, tonic, strengthen the sight and cures eructation (Kirtikar & Basu, 1991). Caraway oil has neurotropic antispasmodic, anti-bacterial and antifungal activity (Anonymous, 1992). Artificially its oil can be converted into thymol that is used as an anthelmintic agent against hook worm infections, antiseptic, and forming part of many proprietary preparations (Nadkarni, 1954)**.** All the three varieties of cumin seeds are digestive, stomachic, carminative, astringent and uterine disinfectant (Khare, 2004).

Therapeutic uses: The drug Zeera Siyah (*Carum carvi* Linn) was used in folk medicine for the treatment of many complains and described in details in ethno-

botanical literature and various uses have been reported. It is useful in diarrhea, dyspepsia, inflammations, catarrh, common cold, cough, bronchitis, fever, inflammation of mouth and pharynx, liver and gall bladder complaints, loss of appetite (Khare, 2004); hoarseness of voice, eczema, abdominal irritation due to worms (Chatterjee & Parkashi, 1995); leukoderma, abdominal tumors, painful womb swelling, piles, malaria (Kurian, 1995); hiccough, dyspepsia, gonorrhea, high coloured urine (Nadkarni, 1954). It also relives gastrointestinal cramps and feelings of fullness, reduces nervous cardiac complaints, spasmodic gastrointestinal complaints, flatulence, irritable stomach, indigestion, dyspepsia in adults, and relieves flatulent colic of infants (Al-Snafi, 2015).

Internally caraway seed has cooling effect and used in gonorrhea. Externally caraway has analgesic effects. its paste reduces pain and irritation due to worms in the abdomen (Chatterjee & Parkashi, 1995). Seeds mixed with lime juice are used to relieve bilious nausea in pregnant females and used internally to improve lactation in nursing mothers (Nadkarni, 1954).

Phyto-chemistry

Chemical composition of the essential oil obtained from the whole plant of *Carum carvi* is as follows: α-Pinene, 0.2; β-Pinene, 0.3; Camphene, 0.3; Myrcene, 1.5; δ-3-carene, 1.0; Limonene, 4.2 γ-terpinene, 2.7; *p*-cymene, 0.3; cadinene, 37.2; myristicine, 1.2; carvyl and dihydrocarvyl acetate, 1.1; dihydrocarvone, 2.3; carvone, 31.2; terpinine-4-ol, 1.2dihydrocaveol, 9.5; and perillyl alcohol, 1.6 %. The caraway seeds contain c3 % water soluble proteins, 3-glucosides and 3-galactosides of kaempferol, quercetin and isorhamnetin and a hydrocarbon. 5-methoxy- and 8-methoxy psoralens, sterol, umbelliferone, scopoletin and herniarin are also present (Anonymous, 1992). *Carum carvi* seeds contain 2- 5 % volatile oil, which consists of 25-35% aldehydes, pinene and alpha terpineol, flavonoids, including apigenin (khare, 2004). Seeds also contain 1–9% essential oils consisting of more than 30 compounds. Carvone and limonene were accounting the main portions (Sedlakova *et al*., 2003; Tewari & Mathela, 2003; Arganosa *et al.*, 1998; Wichtmann & Stahl-Biskup, 1987). The nutritional analysis of *Carum carvi* seeds (100g) showed that they contained water 9.87 g, energy 333 kcal, protein 19.77 g, total lipids (fat) 14.59 g, carbohydrates, by difference 49.90g, fiber, total dietary 38.0 g, sugars, total 0.64g, Calcium 689 mg, Iron 16.23 mg, magnesium 258 mg, phosphorus 568 mg, potassium 1351mg, sodium 17 mg, zinc 5.50 mg, total ascorbic acid 21.0 mg, thiamine 0.3606 mg, riboflavin 0.379 mg, niacin 3.606 mg, vitamin B6 0.360 mg, folate 10 µg, vitamin A (RAE) 18 µg, vitamin A (IU) 363IU, vitamin E 2.50 mg, vitamin, fatty acids, total saturated 0.620 g, fatty acids, monounsaturated 7.125 g and fatty acids polyunsaturated 3.272 g (Anonymous, 2011). Oil distilled from wild seeds usually shows a high specific gravity and hence it is not referred (Nadkarni, 1954). Caraway fruit contains 3-7 % v/m of essential oil, consisting largely of d-carvone (50-65 %), and (+)-limonene (up to 45 %), with less than 1.5 % of carveol and dihydrocarveol. It also contains 10-18 % of fixed oil, of which the main components are petroselinic (30-43 %), linoleic (34-37 %), oleic (15-25 %) and palmitic (4-5 %) acids. Other constituents include about 20 % of protein, about 15 % carbohydrates, phenolic acids, mainly caffeic acid, and traces of flavonoids such as quercetin, kaempferol and their glycosides. Carvenone, carvacrol and peril alcohol are found as distillation and storage artefacts (Anonymous, 2015). Structure of water soluble portion of methanolic extract of *Carum carvi* L. i.e an aromatic compound, glucoside and a glucide are 2-methoxy-2-(4'- hydroxyphenyl) ethanol, junipediol A 2-O-beta-D-glucopyranoside and L-fucitol (Matsumara *et al*, 2002). The exhausted fruits contain crude protein, 20-24 and fat, 14- 16%. The exhausted fruits (seed cake) can be used as cattle feed; they contain: crude protein, 20- 24 and fat, 14- 16%. They are sometimes used as a substitute for the genuine fruits. Leaves contain kaempferol, quercetin and its 3-glucoside. Thick root of caraway contain polyenes falcarindione, falcarinolone and phytofluene besides β- sitosterol, umbelliferone and scopoletin (Anonymous, 1992).

Pharmacological Studies

A number of studies have been carried out on *Carum carvi*, Linn in recent years showing that it possesses diverse pharmacological effects. Some of the important pharmacological effects are as follows

Adaptogenic (antistress) and nootropic activity

Aqueous extract of *Carum carvi* was evaluated for antistress activity in normal and stress induced rats. The study showed that the extract provides scientific support as anti-stress (adaptogenic), antioxidant and nootropic activity in stress induced rats (Koppula *et al.*, 2009).

Anti-bacterial

The antibacterial activity of *Carum carvi* essential oil is apparently due to carvone, limonene, carvacrol, and linalool, which inhibits the growth of *Aspergillus parasiticus* and yeasts and Gram-positive and Gram-negative bacteria. The activity was particularly high against the genera Clavibacter, Curtobacterium, Rhodococcus, Erwinia, Xanthomonas, Ralstonia, and Agrobacterium, which are responsible for plant or cultivated mushroom diseases worldwide (Iacobellis *et al*., 2005).

Caraway essential oil performs medium antimicrobial activity. Hence it inhibits growth of many bacteria and fungi: *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Mycobacterium tuberculosis* (Seidler-Lozykowska *et al.*, 2013).

The oil showed complete inhibition of the growth of the fungi *Aspergillus aegytiacus*, *Penicillium cyclopium* Westling and *Trichoderma viride* Pers (Anonymous, 1992).

Anti diabetic: Ethanolic extract of *Caraway (Carum carvi* L.*)* has hypoglycemic effect in streptozotocin-induced diabetic rats. The hypoglycemic activity of Caraway may be due to inhibition of hepatic glucose production and/or stimulation of glucose utilization by peripheral tissues, especially muscle and adipose tissue (Eidi *et al.*, 2010).

Anti fertility: Endocrinological and physiological changes in the reproductive system of female albino rats were observed after oral administration of different doses of aqueous and ethanolic extracts of *Carum carvi.* They also increase the weight of ovary, uterus and body weight. Caraway has estrogenic activity. It inhibits FSH and LH secretion from pituitary and prevents the development of new follicle in ovary resulting inhibition of ovulation and impairment of fertility and thus leads to contraception (Thakur *et al,* 2009).

Anti hemolytic: Methanolic and acetonic extracts of Caraway seeds were able to neutralize free radicals (can cause hemolysis) and carried antioxidant properties. Caraway seed extracts were able to protect erythrocytes from hemolysis due to the presence of bioactive compounds that perform a radical-scavenging activity (Atrooz, 2013).

Anti spasmodic: *Carum carvi* has anti spasmodic activity and their effect is slightly greater than that of usual dose of atropine on acetylcholine-induced contractions of isolated guinea pig ileum (Khalighi *et al.*, 1988).

Anti-asthma

Caraway has relatively potent relaxant (bronchodilator) effect on the tracheal chain of guinea pig. The β-2 adrenergic receptor stimulatory and / or H1 histamine blocking effect might be contributed to functional antagonist of the essential oil of *Carum carvi* at tracheal muscarinic receptors (Boskabady & Talebi, 1999).

Antioxidant

Caraway has antioxidant activity in streptozotocin induced diabetic rats. It also improved immune functions by increasing total IgE, decreasing inflammatory cytokines (IL-6, IL-1 and TNF) and the decreasing total blood count with increasing neutrophil percent. *Carum Carvi* oil may serve as a natural hypoglycemic antioxidant compound. It may help in attenuating diabetic complications by reducing oxidative stress and improving immune functions (Moubarz *et al*., 2014).

Anti-obesity

Caraway is helpful in the management of obesity because of its bioactive constituents. Caraway extract with no restriction in food intake, when combined with exercise, is of value in the management of obesity in women wishing to lower their weight, BMI, body fat percentage, and body size, with no clinical side effects (Kazemipoor *et al*., 2013).

Bowel motility: To evaluate effect of the *Carum carvi* plant, a gas solvent, on resumption of bowel motility after cesarean section. The study proved that according to the principles of Iranian traditional medicine it is effective to promote bowel function in women after caesarean section (Yosefi *et al.,* 2014).

Gastric action: The Aqueous and ethanolic extracts reduced lesions of gastric mucosal injuries when administrated orally or intraperitoneally at doses of 100-500 mg/kg in several *in vivo* models such as rat models of colitis and gastric mucosal injuries.

Caraway oil reduces lesions when administrated orally or intraperitoneally at doses of 100- 400 µl/kg or 100-300 mg/kg in *in vivo* models of colitis and gastric mucosal injuries in rats (Anonymous, 2015).

Hypoglycemic: *Caraway* has antihyperglycemic activity. Oral administration of *caraway* decreases blood glucose level of treated streptozotocin (STZ) induced diabetic rats (Haidari *et al.,* 2011).

Carum Carvi essential oil mainly Carvone and limonene exhibits a potent hypoglycemic effect in STZ induced diabetic rats and reduces blood glucose in diabetic and *Staphylococcus aureus* infected diabetic rats. Caraway also increases total leucocyte count and total immunoglobulin E and decreases inflammatory cytokines (interleukin 6, interleukin 1 and tumor necrosis factor) in diabetic and diabetic infected rats (Moubarz *et al*., 2014).

Hypolipidemic: Aqueous extract of *Carum carvi* has hypolipidemic property in diet induced hyperlipidemic rats. It reduced lipid levels more, effectively than the simvastatin. Its hypolipidemic effect is due to a counteraction of free radicals by its antioxidants i.e. Quercetin (flavonoids) and Carvone (Saghir *et al*., 2012).

Caraway has hypolipidemic activity in diabetic rats. It caused significant decrease in total cholesterol and low-density lipoprotein cholesterol levels in the treated animals compared with the diabetic control rats, and with no significant change in triglyceride and high density lipoprotein cholesterol levels (Haidari *et al.,* 2011).

Hypothyroidism: *Carum curvi* has property to increase thyroid stimulating hormone (TSH) in hypothyroid patients. Caraway interferes with levothyroxine effect in hypothyroid patients and increase TSH level, but the exact mechanism of action of *Carum carvi* is not known (Naghibi *et al.,* 2015).

Nephroprotective effect

Carum carvi essential oil showed nephroprotection against diabetic nephropathy in streptozotocin induced diabetic rats because carvon, γ-terpinene and Limonene are bioactive compounds of caraway, has strong anti-

oxidant activity and synergistic action (Abou El-Soud *et al.*, 2014).

CONCLUSION

Carum carvi Linn (Zeera siyah) has been in use since times immemorial to treat wide range of indications. It has been subjected to quite extensive phytochemical, experimental and clinical investigations. Experimental studies have been demonstrated its adaptogenic (antistress) and nootropic activity, anti-bacterial, anti diabetic, anti fertility, anti hemolytic, anti spasmodic, anti-asthma, antioxidant, anti-obesity, bowel motility, gastric action, hypoglycemic, hypolipidemic and nephroprotective effect. The scientific studies have proved most of the claims of traditional medicines. However, further detailed clinical research appears worthwhile to explore the full therapeutic potential of *Carum carvi* Linn in order to establish it as a standard drug.

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