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Trachyspermum ammi: A Review on its Multidimensional Uses in Indian Folklore Medicines

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ABSTRACT

Trachyspermum ammi commonly known as 'Ajwain' in India is distributed throughout India and is mostly cultivated in Gujarat and Rajasthan. The fruit possesses stimulant, antispasmodic and carminative properties and is used traditionally as an important remedial agent for flatulence, atonic dyspepsia, diarrhea, abdominal tumors, abdominal pains, piles, bronchial problems, lack of appetite, galactogogue, asthma and amenorrhea. Medicinally, it has been proven to possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive, cytotoxic, hypolipidemic, antihypertensive, antispasmodic, broncho-dilating actions, antilithiasis, diuretic, abortifacient, antitussive, nematicidal, anthelmintic and antifilarial. Further, studies reveal the presence of various phytochemical constituents mainly carbohydrates, glycosides, saponins, phenolic compounds, volatile oil (thymol, γ-terpinene, para-cymene and α and β-pinene), protein, fat, fiber and mineral matter containing calcium, phosphorous, iron and nicotinic acid. These studies reveal that *T. ammi* is a source of medicinally active compounds and have various pharmacological effects; hence, it is encouraging to find its new therapeutic uses.

Key words: *Trachyspermum ammi*, ajwain, gastro protective, antimicrobial, hepato protective, anti-inflammatory

INTRODUCTION

Name for *Trachyspermum ammi* (ajwain) is derived from Sanskrit ajamodaor ajamodika. Examples in modern Indian languages include Kannada ajamoda and Sinhala asamodagam.

Ajwain (pronounced aj'o-wen) is a member of the Apiaceae family, which has some 2,700 members including dill, caraway and cumin. It is mostly found in Indian cooking, where it is also known as bishop's weed or carom (Davidson and Jaine, 2014). Ajwain essential oil showed the presence of 26 identified components which account for 96.3% of the total amount. Thymol (39.1%) was found as a major component along with p-cymene (30.8%), γ-terpinene (23.2%), β-pinene (1.7%), terpinene-4-ol (0.8%) whereas acetone extract of ajwain showed the presence of 18 identified components which account for 68.8% of the total amount. The major component was thymol (39.1%) followed by oleic acid (10.4%), linoleic acid (9.6%), γ-terpinene (2.6%), p-cymene (1.6%), palmitic acid (1.6%) and xylene (0.1%) (Singh *et al*., 2004). Ajwain originated in the Middle East, possibly in Egypt and the Indian subcontinent, but also in Iran and Afghanistan. It is sometimes used as an ingredient in barbered, a spice mixture favored in Eritrea and Ethiopia (Christie *et al*., 2005; Chatterjee and Das, 1967). In India, the major ajwain producing states are Rajasthan and Gujarat,

where Rajasthan produces about 90% of India's total production. Ajwain is an annual herbaceous, 30-70 cm (1-2 ft) in height, bearing feathery leaves and red flowers. When the seeds are ripe, they are dried and threshed (Maton, 1993; Dusenbery, 1996).

Fruit of Ajwain is reported to have antiseptic, antifungal/antibacterial and antithelminitic effects (Morsi, 2000). In Ajwain, the major phenolic compound thymol has been reported to be an antispasmodic, germicide and antifungal agent (Nagalakshmi *et al*., 2000). In the essential oil of *T. ammi*, the principle active constituents of the oil are phenols, mainly thymol (35-60%) and some carvacrol (Tsimidou and Boskou, 1994). Both the phenols thymol and carvacrol are responsible for the antiseptic, antitussive and expectorant properties (Trease and Evans, 2002). Thymol also has antiseptic activity and carvacrol possesses antifungal properties (Menphini *et al*., 1993). The objective of the present study is to review the medicinal value of Ajwain which is used as a natural food additive in many traditional and modern food of Indian origin.

PHARMACOLOGICAL USES

Antiflatulent: Traditionally ajwain is used to allay the retention of gas and flatulence, rural people use ajwain in a very classic way one famous preparation is this to take half kilogram of uncrushed ajwain and 20 g each of the rock salt, black salt and table salt. Put all of these in half kilogram of lemon juice for a few days to be dried at its own. Taking with warm water half to one teaspoonful of this specially prepared ajwain is an excellent home remedy to treat abdominal gas anorexia, nausea, vomiting and travel sickness (Hawrelak *et al*., 2009).

Abdominal pain: A traditional remedy of ajwain for abdominal pain is to make a standard infusion using 2 tsp of bruised seeds or 1 tsp of ajwain powder to 570 mL cold water in a small pan. Bring to a boil, simmer for no more than 2 min and then strain for use. This can be used to treat respiratory and digestive infections, asthma, colic griping pains, cramp muscle spasms, edema, rheumatism and arthritis. It can also be used externally as an antiseptic to clean wounds and treat skin infections. As with all medicinal herbs, it's important that ajwain is grown organically to avoid its intrinsic properties being partly or completely eliminated by the presence of foreign substances (Ramaswamy *et al*., 2010; Platel and Srinivasan, 2001).

Anti-spasmodic: The seeds of ajwain are the part used for medicine, though the oil can also be used, but it's difficult to distil oil at home. The seed can also be powdered in a coffee grinder or similar device and tied tightly in a thin cloth to treat migraine headaches and heavy colds by inhaling the aroma frequently throughout the day. Take 100 g of ajwain, 50 g of ginger power and 25 g of black salt and crush them together to be put in a dry container. As a ready remedy to manage mild to moderate abdominal spasms take 2 g of this powder with warm water 2 or 3 times a day or whenever required. Applying hot formation on the area of pain will bring faster relief (Platel and Srinivasan, 2001; Murthy *et al*., 2009).

Gastro protective activity: *Trachyspermum ammi* fruit showed antiulcer activity by using different ulcer models. Animals pre-treated with ethanolic extract showed significant decrease in ulcer index and percentage ulcer protection in all models. The results suggest that the extract showed significant protection by reducing ulcerative lesions when compared with control group of animals (Platel and Srinivasan, 2001).

Digestive stimulant actions: *Trachyspermum ammi* would increase the secretion of gastric acid nearly four-fold by *T. ammi*. In experimental rats *in vivo*, the addition of *T. ammi* to the diet reduced food transit time and also enhanced the activity of digestive enzymes and/or caused a higher secretion of bile acids (Platel and Srinivasan, 2001).

Antimicrobial actions: The antimicrobial actions of *T. ammi*, in the protection of food stuffs against microbial spoilage, conducting laboratory assays of antimicrobial efficacy *in vitro* and its use as antimicrobials in humans are also investigated. The active principles thought to be responsible for the antimicrobial activity of ajwain were reported to be carvacol and thymol. Thymol kills the bacteria resistant to even prevalent third generation antibiotics and multi-drug resistant microbial pathogens and thus works as a plant based 4th generation herbal antibiotic formulation (Caccioni *et al*., 1998; Saxena and Vyas, 1986).

Antifungal activity: Antifungal action of volatile constituents of *T. ammi* seeds on 10 fungi (*Acrophialophora fusispora*, *Curvularia lunata*, *Fusarium chlamydosporum*, *F. poae*, *Myrothecium roridum*, *Papulaspora* sp., *Alternaria grisea*, *A. tenuissima*, *Drechslera tetramera* and *Rhizoctonia solani*) was tested and found to inhibit the growth of all test fungi by 72-90%. Phenolic compounds, such as thymol and carvacol, are known to be either bactericidal or bacteriostatic agents depending on the concentration used (Singh *et al*., 1979, 2004).

Anti-inflammatory potential: Anti-inflammatory potential of the Total Alcoholic Extract (TAE) and Total Aqueous Extract (TAQ) of the Ajwain seeds was determined. The TAE and TAQ exhibited significant ($p<0.001$) antiinflammatory activity in both the animal models. The weights of the adrenal glands were found to be significantly increased in TAE and TAQ treated animals. The TAE and TAQ extracts from the ajwain seeds exhibit significant anti-inflammatory potential (Thangam and Dhananjayan, 2003).

Antitussive effects: The antitussive effects of aerosols of two different concentrations of aqueous and macerated extracts and carvacrol, codeine and saline were tested by counting the number of coughs produced. The results showed significant reduction of cough number obtained in the presence of both concentrations of aqueous and macerated extracts and codeine ($p<0.001$ for extracts and $p<0.01$ for codeine) (Boskabady *et al*., 2005).

Hepatoprotective activity: The hepatoprotective actions *in vivo* showed that *T. ammi* was 80% protective in mice against a normally-lethal dose of paracetamol (1 g kg^{-1}), it prevented the CCl_4^- induced prolongation of pentobarbital sleeping time in mice and it tended to normalize the high serum levels of liver enzymes caused by CCl_4^- induced liver damage in rats (Gilani *et al*., 2005).

Antihypertensive and broncho-dilating activity: The antihypertensive effect of *T. ammi* administered intravenously *in vivo* and the antispasmodic and broncho-dilating actions. *In vitro* showed that calcium channel blockade has been found to mediate the spasmolytic effects of plant materials and it is being considered that this mechanism contributed to their observed result and supported the traditional use of *T. ammi* in hyperactive disease states of the gut such as colic and diarrhea as well as in hypertension (Gilani *et al*., 2005).

Antiplatelet-aggregatory: Antiplatelet-aggregatory experiments *in vitro* with blood from human volunteers, it that a dried ethereal extract of *T. ammi* seeds, inhibited aggregation of platelets induced by arachidonic acid, collagen and epinephrine. Research study was intended to support the traditional use of *T. ammi* in women post parturition (Srivastava, 1988).

Hypolipidemic action: Antihyperlipidemic effect of *T. ammi* seed has been obtained in albino rats. It was assessed that *T. ammi* powder at a dose rate of 2 g kg^{-1} body weight and its equivalent methanol extract were extensively effective in lipid lowering action by decreased total cholesterol, LDL-cholesterol, triglycerides and total lipids (Javed *et al*., 2002).

Antilithiasis and diuretic activity: Antilithiasis and diuretic actions *in vivo* of *T. ammi* on inhibiting oxalate urolithiasis induced in rats were studied. It was found that *T. ammi* was not effective in increasing the 24 h urine production. The results concluded that the traditional use of *T. ammi* in the treatment of kidney stones was not supported by their experimental evidence (Ahsan *et al*., 1989).

Abortifacient and galactogogic actions: *Trachyspermum ammi* is listed in 14 indigenous medicinal plants that were reported to have been used for abortion in some districts of Uttar Pradesh (India) in their survey conducted in 1987. Specifically, in the village of Kallipuschium, Lucknow district, 50 of the 75 pregnant women who were surveyed (of a total of 155 women in the fertile period) claimed to have used *T. ammi* seed for abortion. The herb was not 100% effective and so the possibility of causing congenital defects was of concern. There was a high risk of potential human fetotoxicity of ten plants including *T. ammi*, based on teratogenicity observed in rat fetuses (Nath *et al*., 1997).

The National Dairy Research Institute in India investigated the estrogenic content of some herbs (including *T. ammi*) that are traditionally used to increase milk yield in dairy cattle. *Trachyspermum ammi* has also been traditionally used as a galactogogue in humans. The total phytoestrogen content of dry *T. ammi* seed was 473 ppm, which was the second highest in the list of eight herbs tested (total phytoestrogen contents 131-593 ppm) (Kaur, 1998).

Detoxification of aflatoxins: The seed extract of ajwain showed the maximum degradation of aflatoxin G1 (AFG1). The aflatoxin detoxifying activity of the seeds extract was significantly reduced upon boiling. Significant levels of degradation of other aflatoxins viz. AFB1, AFB2 and AFG2 by the dialyzed seeds extract were also observed. Time course study of AFG1 detoxification by dialyzed *T. ammi* extract showed that more than 91% degradation occurred at 24 h and 78% degradation occurred within 6 h after incubation (Priestley *et al*., 2003).

Ameliorative effect: Effects of ajwain extract on hexachlorocyclohexan (HCH)-induced oxidative stress and toxicity in rats were investigated. Pre-feeding of ajwain extract resulted in increased GSH, GSH-peroxidase, G-6-PDH, SOD, catalase, Glutathione-S-Transferase (GST) activities and decreased hepatic levels of lipid peroxides. It was concluded that HCH administration resulted in hepatic free radical stress, causing toxicity, which could be reduced by the dietary ajwain extract (Singh *et al*., 2004).

Nematicidal activity: Pine Wilt disease is caused by the pinewood nematode (PWN), *Bursaphelenchus xylophilus*. Nematicidal activity of ajwain oil constituents (camphene, pinene, myrcene, limonene, terpinene, terpinen-4-ol, thymol and carvacrol) is against PWN. Amino and hydroxyl groups have been hypothesized as target sites of methyl isothiocyanate in nematodes. Some essential oils have been reported to interfere with the neuromodulator octopamine or GABA gated chloride channels of insect pests. Thymol and carvacrol are very effective against PWN. These studies confirm that the nematicidal activity of ajwain oil is mainly attributed to the activity of thymol and carvacrol (Kong *et al*., 2006; Park *et al*., 2007).

Anthelmintic activity: Anthelmintic activity of *T. ammi* shows its effect against specific helminths, e.g. *Ascaris lumbricoides* in humans and *Haemonchus contortus* in sheep. Anthelmintic activity of *T. ammi* is exerted by interference with the energy metabolism of parasites through potentiation of ATPase activity and thus loss of energy reserves. The plant has also been reported to possess cholinergic activity with peristaltic movements of the gut, thus helping in expulsion of intestinal parasites which might also be a contributory factor to its anthelmintic activity (Jabbar *et al*., 2006).

Antifilarial activity: *In vitro* activity of the methanolic extract of the fruits of *Trachyspermum ammi* against Setaria digitata worms has been investigated. The crude extract and the active fraction showed significant activity against the adult *S. digitata* by both a worm motility and MTT reduction assays. The isolated active principle phenolic monoterpene screened for *in vivo* antifilarial activity against the human filarial worm *B. malayi* in *Masto myscoucha* showed macrofilaricidal activity and female worm sterility *in vivo* against *B. malayi. Trachyspermum ammi* crude extract exhibited macrofilaricidal activity. The IC_{50} values for the isolated active principle 2- isopropyl-5-methyl phenol at two incubation periods 24 and 48 h were 0.024 and 0.002 mg mL^{-1}, respectively. The *in vivo* effect of the active principle 2-isopropyl-5-methyl phenol was evaluated against the *B. malayi* parasite in a *Masto myscoucha* model. The mean percentage mortality of adults (58.93%) in the group treated with 50 mg kg^{-1} was significantly ($p<0.0001$) higher than that was obtained in the control group (19.05%) (Mathew *et al*., 2008).

Amebiasis: In the Unani system, Ajwain is used as a crude drug to enhance the body's resistance and is prescribed in amebiasis (Bairwa, 2011).

CONCLUSION

This study conclude that *T. ammi* is a source of medicinally active compounds and have various pharmacological effects, hence, it is encouraging to find its new therapeutic.

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