

Pharmaceutical Benefits and Multidimensional uses of Ajwain (*Trachyspermum ammi* L.)

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ABSTRACT

Introduction: Ajwain (*Trachyspermum ammi* L.) seeds are derived from a herb plant of the family Apiaceae. It is also known as Ajowan caraway, bishops weed or carom and has substantial medicinal properties.

Methods: The keywords of Ajwain, traditional medicine, health benefits, pharmaceutical science and health benefits were searched in Google Scholar, Scopus, ResearchGate and PubMed. **Results:** Ajwain oil has a wide range of medicinal applications, such as antibacterial, antifungal, anti-inflammatory, antioxidant, antibacterial, cytotoxic, antilithiasis, nematocidal, anthelmintic, and antifilarial activities. The seeds have stimulant, sialagogue, stomachic, carminative, aromatic, antiseptic, antihypertensive, antispasmodic, antiparasitic, antihistamine, antiscorbutic, vermicide, emmenagogue, digestive and antiseptic properties. **Conclusion:** Ajwain is one of the most important medicinal plants and can promote good health

and serve as a nutrition therapy on the basis of traditional Asian medicine.

Key words: Ajwain, Traditional Medicine, Health Benefits, Natural products.

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INTRODUCTION

Natural products such as essential oil are used for various purposes which are produced by the secondary metabolism in plants.¹⁻⁴ Plants are known as bioreactors and are economically safe for production of antimicrobial, antibacterial and antifungal agents.⁵⁻⁸ Ajowan is also an annual and highly valued medicinally important seed spice which has many native ecotypes in different parts of Iran.^{9,10} *Trachyspermum ammi* L., known as Zenyan or Nankhan in Persian language, belongs to the Apiaceae family. Its seeds have stimulant, antioxidant, antitussive, antihypertensive, antimicrobial, antibacterial, carminative, diuretic, nematocidal, and hypolipidemic effects.^{11,12} The high content of antioxidants, mainly polyphenols and flavonoids, make it a probable source for developing nutraceuticals.¹³ According to Persian traditional medicine, it is hot and dry in the third degree and also possesses some bitterness and acidity.¹¹ The main goal of this mini-review is to survey the chemical constituents and the most important pharmaceutical benefits of Ajwain.

Chemical components of Ajwain

Various phytochemicals including alkaloids, chalcones, coumarins, flavonoids, glycosides, saponins, steroids and tannis have been reported in ajwain.^{14,15} It is also rich in carbohydrates, protein, ash, fiber and fat contents.¹⁶ Singh *et al.*¹⁷ showed that steam distilled volatile oil obtained from *T. ammi* composed of nine monoterpenes which include seven hydrocarbons (97.1%) and two alcohols (2.9%). The predominant monoterpenes were γ -terpinene (35%), α -phellandrene (31.4%), *o*-carene (19.3%), *p*-mentha-1,3,8 triene (8.8%), *p*-cumin-7-ol (2.7%), β -pinene (1.9%), β -myrcene (0.4%), *cis*-myrtenol (0.2%) and *Ot*-pinene (0.3%). Thymol (72.03, 71.80%) is found to be the major constituent of seeds, followed by γ -terpinene and ρ -cymene; other estimated % age of nutritional compositions are protein, ash, moisture, fats, fiber, and carbohydrate.¹⁸ Davazdahemami *et al.*¹⁹ reported that in the spring planting date, thymol was the main constituent in seed (44.5%) and in foliage (20%), followed by γ -terpinene (26.6% and 21%), ρ -cymene (21.6% and 10.8%), limonene (1.1% and 0.3%) and carvacrol (0.3% and 3.6%). In the summer planting date, the most important components

identified in seed and foliage oils were thymol (55.5% and 56.2%), γ -terpinene (22.5% and 26.9%), ρ -cymene (14.2% and 11.2%), limonene (1.9% and 0.5%) and carvacrol (0.3% and 1.4%), respectively. However, Kambouche and El-Abed²⁰ reported that the major constituents from oil obtained by hydrodistillation of *T. ammi* in Algeria were isothymol (51.1%), ρ -cymene (14.1%), thymol (13.0%), limonene (11.8%) and γ -terpinene (6.8%). Dhaiwal *et al.*²¹ demonstrated that a methanol extract exhibited higher antioxidant activity in 2,2-diphenyl-1-picrylhydrazyl (IC₅₀ value 130 μ g/mL), hydroxyl radical (IC₅₀ value 120 μ g/mL), nitric oxide (IC₅₀ value 90 μ g/mL) scavenging assays, and the highest ferric reducing antioxidant power (FRAP) value (780 μ g Fe (II)/g fry weight) compared to hexane and dichloromethane extracts. Akhlaghi *et al.*²² identified 44 compounds by GC and GC/MS in North East of Iran, and the main components of oil were hexadecanoic acid (27.5%), ethyl linoleate (8.5%), 6-methyl- α -ionone (8.0%), isobutyl phthalate (5.8%), α -cadinol (4.7%), and germacrene D (4.3%).

Medicinal benefits of Ajwain

T. ammi is rich source of volatiles and phenolics exhibiting significant antioxidant and anticholinesterase activities.²³ It has been used internally as household folk medicine for the remedy of cough, cold, asthma, diarrhea, influenza, cholera, appropriate for stimulating the appetite and is recommended to cure stomach discomfort, smooth functioning of the respiratory system and the kidneys.²⁴ It has been reported that the dietary threonine levels and Ajwain seed supplement individually improved growth performance, ileal microbial population and jejunum morphology of broiler chickens.²⁵ A 3% Ajwain extract gave the best shelf life to the refrigerated fish product.²⁶ Noori *et al.*²⁷ reported that ajwain and lactic acid can be used to extend shelf-life of common carp. Kedia *et al.*²⁸ reported efficacy of *T. ammi* essential oil against fungal and aflatoxin contamination *in vivo*, and as a plant based food preservative. Ajwain essential oil and its major constituents have toxic effects on *Tuta absoluta* larvae, as ajwain essential oil and its constituents inhibited activity of AChE *in vivo* and *in vitro*, and thymol highly synergized the toxicity of

Table 1: Pharmaceutical benefits of Ajwain.

Pharmaceutical benefits	Key points	Reference
Acaricidal activity	<i>Trachyspermum ammi</i> demonstrate considerable effect on <i>Dermanyssus gallinae</i> .	33
Anthelmintic effects	Both crude powder (CP) and crude aqueous extract (CAE) of <i>T. ammi</i> seeds had dose dependent anthelmintic effects. <i>T. ammi</i> is a promising alternative for the treatment and prevention of helminths in livestock.	34
Anti-bacterial effects	The effects of seed extract and essential oil on <i>Pseudomonas viridiflava</i> , <i>Pseudomonas syringae</i> pv. <i>syringae</i> and <i>Escherichia coli</i> have been reported.	35
Anti-cancer effects	The chemopreventive potential of <i>Trachyspermum ammi</i> seeds against carcinogenesis for doses of 2%, 4% and 6% have been reported.	36
Antioxidant activity	Its antioxidant activity may be mainly due to the presence of thymol and strong synergism between all monoterpenes and monoterpenoids components of essential oils.	37,38
Anti-inflammatory effects	<i>T. ammi</i> essential oil (TAE0) lowers lipopolysaccharide induced nitric oxide synthesis in macrophages. *TAE0 downregulates inducible nitric oxide synthase and hem oxygenase-1 expression.	39
Anti-fungal	Thymol and eugenol are the major contributors to the fumigant antifungal activities against the <i>Aspergillus</i> species <i>A. ochraceus</i> , <i>A. parasiticus</i> and <i>A. niger</i> .	40
	<i>T. ammi</i> possess antifungal activity due to the presences of its organic phenolic compounds.	41
	<i>T. ammi</i> seed ethanolic and hexane fractions possess potential antifungal effects against <i>Candida albicans</i> , and the minimal inhibitory concentration of the hexane fraction was found to be 225 µg/mL.	42
	Its essential oil possessed strong mycelia growth inhibition of virulent strains of <i>Candida</i> and <i>Aspergillus</i> species.	43
Antitermitic effects	Ajwain essential oil showed antitermitic effects.	44
Hypotensive effects	<i>T. ammi</i> contains a calcium channel blocker constituent (thymol), which is the main reason of bradycardiac and hypotensive effects in <i>in vivo</i> studies.	45
Nematicidal effects	Ajwain essential oil showed nematicidal effects.	46
Scolicidal effects	Ajwain essential oil exhibited scolicidal effects.	47
Skin diseases	As an antiseptic, the extract of ajwain can be applied externally to clean wounds and skin infections.	48,49
	Topical ajwain gel has been proven for the treatment of mild to moderate facial acne.	50

γ -terpinene and *p*-cymene.²⁹ Khan *et al.*³⁰ reported the putative cariostatic properties of *T. ammi* which can be used as an alternative medicine to prevent caries infection. The potential of *T. ammi* anticalcifying protein (TAP) in preventing calcium oxalate deposition and forms the basis for the development of antilithiatic drug interventions against urolithiasis.³¹ Acidity, burning sensation and mouth ulcer are the most possible side effects of *T. ammi* and the essential oil isolated from Ajowan seeds showed cytotoxic activity against P388 mouse leukemia cells.³² The most important pharmaceutical benefits of Ajwain are shown in Table 1.

CONCLUSION

T. ammi is a rich source of volatiles and phenolics, exhibiting significant antioxidant and anticholinesterase activities. Thymol is the major constituent of the seeds, followed by γ -terpinene and *p*-cymene. Ajwain oil contributes to a wide range of medicinal applications including antibacterial, antifungal, anti-inflammatory, antioxidant, antibacterial, cytotoxic, antilithiasis, nematicidal, anthelmintic and antifilarial activities. The seeds can be used as a stimulant, sialagogue, stomachic, carminative, aromatic, antiseptic, antihypertensive, antispasmodic, antiparasitic, antihistamine, antiscorbutic, vermicide, emmenagogue, digestive and has antiseptive properties.

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CONFLICT OF INTEREST

The authors declare that they have no potential conflicts of interest.

ABBREVIATIONS

TAP: *T. ammi* anticalcifying protein.

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PICTORIAL ABSTRACT



Digestive Health	Infection Prevention	Lower Blood Pressure	Cough and Congestion Relief	Toothache Relief
Arthritis Pain Relief	Regulates Cholesterol levels	Fight Inflammation	Prevent Kidney Stones	Helps in Diabetes Mellitus



Cholera Disease	Weight Loss	Prevention of Acidity	Cleaning Wounds and Burns
Helps in Treating Excessive Bleeding and Irregular Periods			
Acts as an Excellent Mosquito Repellent			
Fights Against Fungi and Harmful Bacteria			



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Dr. Wenli Sun is an assistant researcher working on related topics of traditional Chinese medicine, allopathic influence and sustainable agriculture. She is also working on topics which are related to Biotechnology and Molecular Sciences.



Prof. Dr. Qi Cheng is a professor of Biotechnology and his researches have connected with agrobiotechnology. Presently, he is interested to traditional Chinese medicine and molecular researches.