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A Review on Phytochemical Constituents and Activities of Trachyspermum Ammi(L.) Sprague fruits

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ABSTRACT

Trachyspermum ammi (L.) sprague fruits is commonly called Ajowan belongs to the family 'Apiaceae'. It's fruits yielded 2% to 4% brownish essential oil, with thymol as the major constituent (35% to 60%). It also contain monoterpenoids and reported some new constituents. The plant is used traditionally as a stimulant, carminative, flatulence, atonic dyspepsia, diarrhoea, abdominal tumours, abdominal pains, piles, and bronchial problems, lack of appetite, galactogogue, asthma and amenorrhoea. It possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive, cytotoxic activity, hypolipidaemic, antihypertensive, antispasmodic, broncho-dilating actions, antilithiasis, diuretic, abortifacient, antitussive, nematicidal, anthelmintic and antifilarial activity. This review deals with the evidence-based information regarding the pharmacological activity of *Trachyspermum ammi*.

Key words: *Trachyspermum ammi*, Apiaceae, Ajowan fruits, constituents, pharmacological activities.

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INTRODUCTION

Trachyspermum ammi (L.) sprague is an annual herbaceous plant bearing the greyish brown fruits or seeds. An erect, glabrous or minutely pubescent, branched annual, up to 90 cm tall, cultivated almost throughout India. Stems striate; leaves rather distant, 2-3 pinnately divided segments linear, ultimate segments 1.0-2.5 cm long; flowers in terminal or seemingly-lateral pedunculate, white, small; fruits ovoid, muricate, aromatic cremocarps 2-3 mm long, compounds umbels, grayish brown; mericarp compressed, with distinct ridges and tubercular surface, one-seeded. Flowers and fruits bearing from January – April ^{1,2}.



Figure: 1 *Trachyspermum ammi* (L.) Sprague fruits

Vernacular names

Hindi - Ajwain

English - Bishop's weed

Sanskrit - Dipyaka, Yamini, Yaminiki, Yaviniki

Punjabi – Lodhar

Bengali - Yamani, Yauvan, Yavan, Javan, Yavani

Gujrati - Ajma, Ajmo, Yavan,

Javain; Kannada - Oma, Yom, Omu;

Kashmiri - Kath;

Malayalam – Omam

Marathi – Onva

Oriya – Juani

Tamil – Omam

Telugu - Vamu ¹.

Distribution and habitat

It belongs to the family 'Apiaceae' comprising 270 genera and species, mostly grown in the

temperate regions of the world but species which are cultivated in tropics regions. Ajwain is grown in Iran, Egypt, Afghanistan and India (largely in Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Rajasthan, Bengal, Tamil Nadu and Andhra Pradesh). It is generally grown in October-November and harvested in May -June. Though the plant is widely cultivated, it is indigenous to Egypt where it grows as a common weed in the fields.

Medicinal uses

In Indian system of medicine, ajwain is administered for stomach disorders, a paste of crushed fruits is applied externally for relieving colic pains; and a hot and dry fomentation of the fruits is lapped on the chest to cure asthma³. Ajwan-ka-arak (aqueous extract) is popular preparation for diarrhoea. Therapeutic uses of *T. ammi* fruits include stomachic, carminative, expectorant, antiseptic, amoebiasis and antimicrobial activity. It also cures abdominal tumor, abdominal pains and piles⁴. It's also prescribed to comfort dipsomania, hysteria, sore throat; many ajowan ayurvedic formulations are available which is given to overcome infections with worms⁵. It is also used for relieving flatulence, dyspepsia, spasmodic disorders, flatulence, common cold, acute pharyngitis, sore and congested throat.

Adulteration

Ajowan seed is available both as whole and in ground form. It adulterated by addition of exhausted or spent seed (from which oil or oleoresin has been extracted) excess stems, chaff and earth or dust. The oil is also adulterated with ajowan chaff oil. The range of essential oil is 2–4% and it should contain thymol ranging from 35 to 60%. If chaff oil is added, the thymol content will reduce to below 35%. The oleoresin may be adulterated by adding synthetic saturated acid. Detection of these adulterants can be done by gas chromatography or by thin layer chromatography coupled with high-performance liquid chromatography. The adulteration at any level can be detected by using the specifications as explained separately for whole seed, powdered seed, volatile oil and oleoresin⁶.

The seeds are sometimes adulterated with *ban ajwain* [*Seseli diffusum* (Roxb. ex. Sm.)] or *randhuni* [*Apium graveolens* (Linn.) Sprague]. The adulteration can be detected by thin layer chromatography using benzene: petrol (1:7)¹.

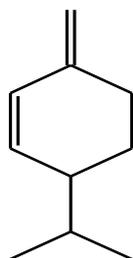
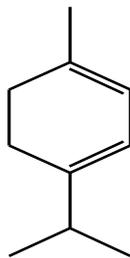
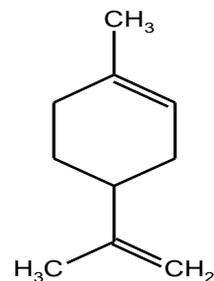
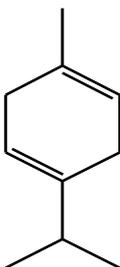
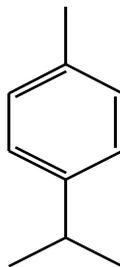
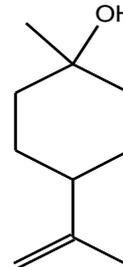
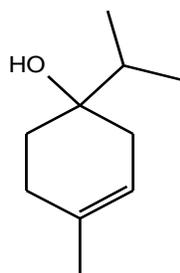
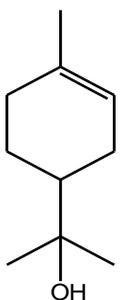
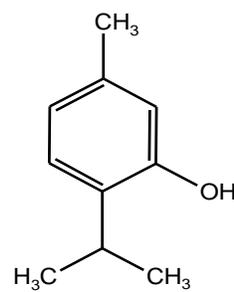
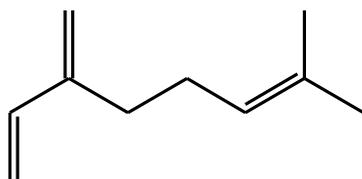
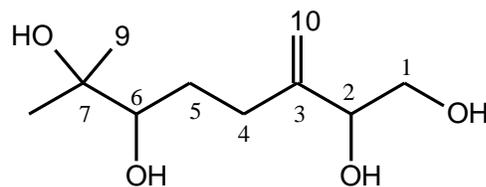
Reported phytoconstituents

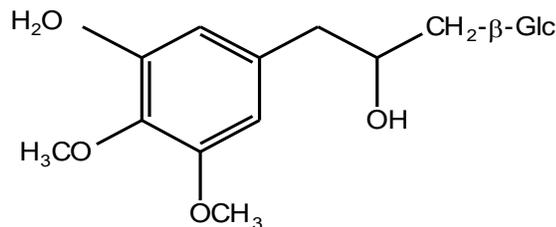
- Ajwain seed possessed fibre (11.9%), carbohydrates (38.6%), tannins, glycosides, moisture (8.9%), protein (15.4%), fat (18.1%), saponins, flavone and mineral matter (7.1%) containing calcium, phosphorous, iron and nicotinic acid⁷.

- The Ajwain fruits yielded 2% to 4% brownish essential oil, with thymol as the major constituent (35% to 60%)¹.
- GLC and GC-MS analysis of the oil resulted in the identification of many components comprising α -thujene, α -pinene, sabinene, β -pinene, α -phyllyanderene, γ -terpinene p-cymene, β -phyllyanderene, terpinene-4-ol, thymol, carvacrol, styrene and δ -3-carene⁸.
- From the fruits 6-O- β -glucopyranosyloxythymol have been isolated. Two new compounds 6-hydroxycarvacrol 2-O- β -D-glucopyranoside and 3,5-dihydroxytoluene 3-O- β -D-galactopyranoside have been reported as glycosyl constituents⁹.
- 25 compounds, including five new monoterpenoid glucosides, a new monoterpenoid, two new aromatic compound glucosides, and two new glucides, were obtained from the water-soluble portion of the methanol extract of the fruit of *Carum copticum*. Their structures were clarified by spectral investigation. A monoterpenoid 3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol (a mixture of two stereoisomers) were identified. Monoterpenoid glucosides A, B, C, D, E, F, G and H were identified as (2S,6Z)-3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol 1-O- β -D-glucopyranoside; 6-hydroxythymol 6-O- β -D-glucopyranoside; 6-hydroxythymol 3-O- β -D-glucopyranoside¹⁰; C₁₆H₂₄O₇ as 7-hydroxythymol 3-O- β -D glycopyranoside; C₁₆H₂₈O₇ as (4R,6S)-p-menth-1-ene-4,6-diol 4-O- β -D-glucopyranoside; C₂₂H₃₄O₁₂ as 6-hydroxythymol 3,6-di-O- β -D-glucopyranoside; C₁₆H₂₈O₇ as (4S)-p-menth-1-ene-4,7-diol 4-O- β -D-glucopyranoside; C₁₆H₂₈O₇ (4R,6S)-p-menth-1-ene.4,6-diol 4-O- β -D-glucopyranoside ; C₁₆H₂₆O₇ as 3 β -hydroxy-p-menth-1-en-4 β , 5 β -oxide 3-O- β -D-glucopyranoside respectively. Among them D, E, F, G and H are new monoterpenoids glucoside. A New monoterpenoid were identified and its structure was established as p-menth-3-ene-1 β , 2 β , 5 β -triol¹¹.
- Alkyl glucoside, aromatic compound glucoside and aromatic compound were identified as 2-methyl-3-buten-2-ol- β -D-glucopyranoside benzyl- β -D-glucopyranoside and 19-(3-hydroxy-4,5-dimethoxyphenyl)-propane-29, 39-diol respectively¹².
- A new aromatic compound glucoside C₁₅H₂₂O₈ was characterized as 3,4-dihydroxyphenylpropanol-3-O- β -D-glucopyranoside¹¹.
- Nucleosides were identified as adenosine and uridine and glucides were identified as, (2S, 3R)-2-methylbutane-1,2,3,4-tetrol¹²) and (3R)-2-hydroxymethylbutane-1,2,3,4-tetrol respectively¹².
- Two new glucosides were identified as 1-deoxy-L-erythritol (C₄H₁₀O₃) and 1-deoxyxypentitol (C₅H₁₂O₄)¹¹.

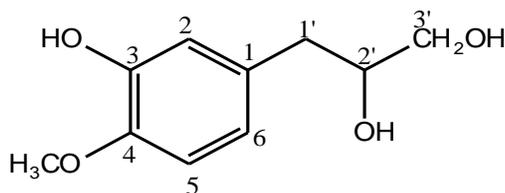
- Fruits of ajwain contain various minerals like aluminium, calcium, cadmium, copper, iron and lithium whereas nitrates and nitrite were not detected in Ajowan fruit ¹³.
- The fruits afforded riboflavin, thiamine, nicotinic acid, carotene, calcium, chromium, cobalt, copper, iodine, iron, manganese, phosphorus and zinc ¹⁴.

Structures of reported phytoconstituents:

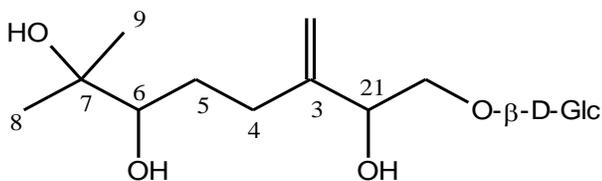
**β-Phellandrene****α-Terpinene****Limonene****γ-Terpinene****p-Cymene****Cis-β-terpineol****4-Terpineol****α-Terpineol****Thymol****β-Myrcene****3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol**



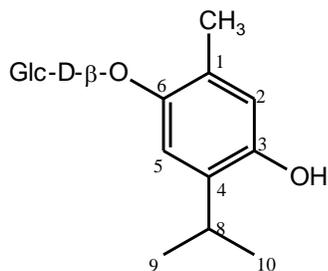
1'-(3-hydroxy-4,5-dimethoxyphenyl)propane-2',3'-diol-3'-O-β-D-glucopyranoside



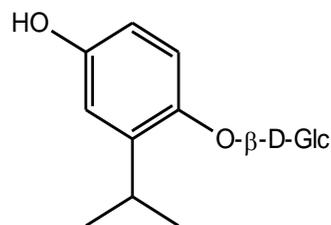
1'-(3-hydroxy-4,5-dimethoxyphenyl)propane-2'-3'-diol



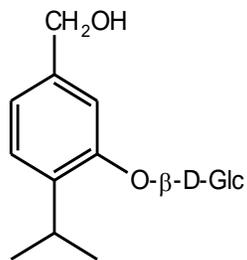
(2S,6Z)-3,7-dimethyloct-3(10-ene)-1,2,6,7-tetrol-4-O-β-D-glucopyranoside



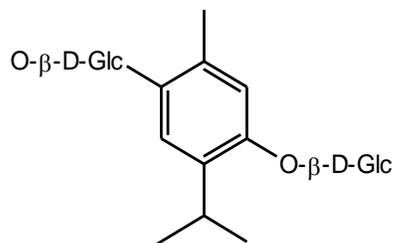
6-hydroxythymol-6-O-β-glucopyranoside



6-hydroxythymol-3-O-β-glucopyranoside



7-hydroxythymol-3-O-β-glucopyranoside



6-hydroxythymol-3,6-di-O-β-glucopyranoside

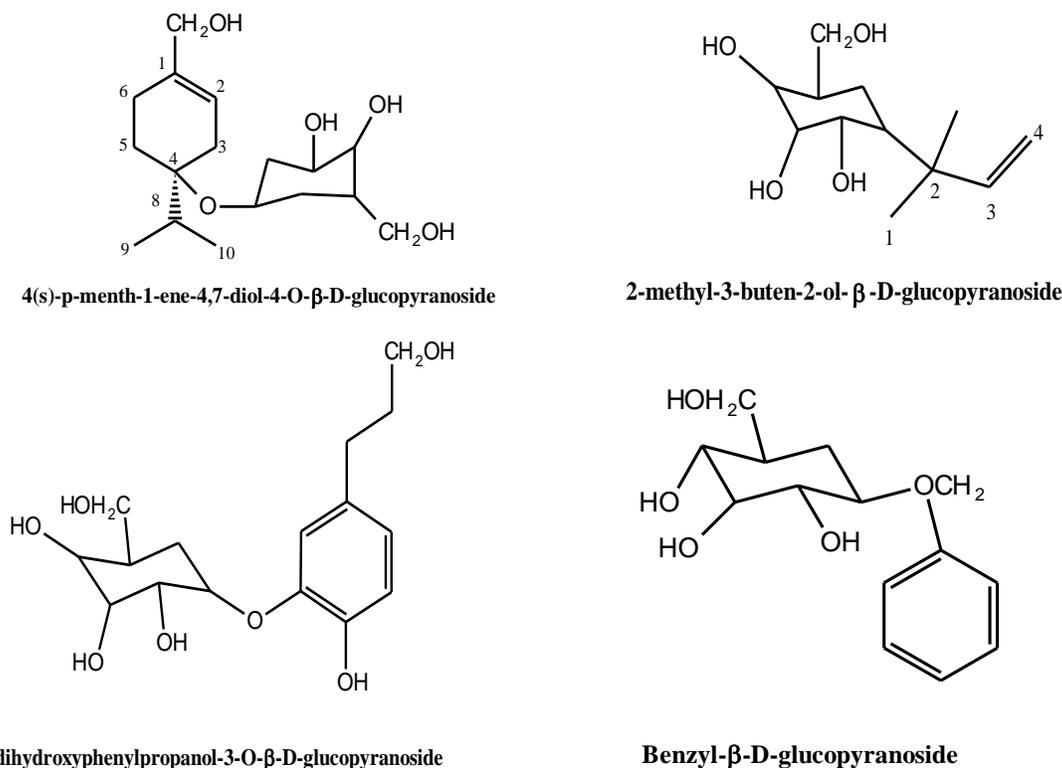


Figure: 2 Reported phytoconstituents of ajowan fruits

REPORTED BIOACTIVITIES

Analgesic effect

Ethanol extract of *T. ammi* fruits proved analgesic activity by using a tail-flick analgesiometer device that showed significantly increase in tail-flick latency (TFL) during 2 h post-drug administration¹⁵.

Antibacterial activity

Acetone and aqueous extracts of *T. ammi* were tested against *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Salmonella typhimurium* and *Shigella flexneri* by using agar diffusion assay¹⁶. Methanolic extract of seed of *T. ammi* tested against 11 bacterial species *Pseudomonas aeruginosa* and *Basillus pumilus*; *Staphylococcus aureus* and *Staphylococcus epidermidis*; *Escherichia coli*, *Klebsiella pneumonia* and *Bordetella bronchiseptica* respectively and showed significant antibacterial activity¹⁷.

Antifilarial activity

A methanolic extract of fruits of *T. ammi* was exhibited activity against adult bovine filarial *Setaria digitata* worms. It's showed antifilarial activity against the human filarial worm *B. malayi* in *Mastomys coucha*, showing macro filaricidal activity. The research thus provided a

new way for development of a macrofilaricidal drug from natural products ¹⁸.

Antifungal activity

T. ammi essential oil showed fungicidal effect on *Aspergillus niger* and *Curvularia ovoides* at 5000 ppm as minimum inhibitory concentration ¹⁹.

Anthelmintic Activity

T. ammi exhibited its effect against specific helminths, e.g. *Haemonchus contortus* in sheep and *Ascaris lumbricoides* in humans. Its anthelmintic activity is due to loss of energy reserves by interference with the energy metabolism of parasites through potentiation of ATPase activity ²⁰. A contributory factor to its anthelmintic activity is due to possess cholinergic activity that interfere peristaltic movements of the gut ²¹.

Insecticidal activity

The essential oils exhibited insecticidal activity due to their oviposition, egg hatching and developmental inhibitory activities were determined against pulse beetle, *Callosobruchus chinensi*. These essential oils also caused chronic toxicity as the fumigated insects caused less damage to the stored grains ²².

Antiplatelet activity

T. ammi ethereal extract was found to inhibit platelet aggregation induced by arachidonic acid (AA), epinephrine and collagen. Inhibition of aggregation by ajwain could be explained by its effect on platelet thromboxane production (i.e. reduced TxB2 formation in intact platelet preparations from added arachidonate and it also reduced the formation of TxB2 from AA-labelled platelets after stimulation with Ca²⁺-ionophore A23187 by a direct action on cyclooxygenase) ²³.

Antioxidant activity

Seeds of *T. ammi* exhibited antioxidant activity by using ABTS and DPPH assay methods, ferric reducing antioxidant power and total phenolic content ²⁴.

Its ethanolic extract of ajwain shows activity against hexachloro cyclohexane (HCH) induced lipid peroxidation ²⁵.

Antihistaminic effect

Macerated, aqueous and ethanolic extracts and essential of *T. ammi* were studied on guinea pig tracheal chains. The results showed clear rightward shifts in histamine response curves which indicated a competitive antagonism effect of *T. ammi* at histamine H₁ receptors ²⁶.

Antiviral activity

T. ammi were screened for their inhibitory effects on hepatitis C virus (HCV) protease (PR)

using in vitro assay methods and showed significant inhibitory activity ($\geq 60\%$ inhibition at 100 micro g/mL)²⁷.

Enzyme modulation activity

Acetyl cholinesterase, lactic dehydrogenase, succinic dehydrogenase and cyto oxidase activity in the nervous-tissue of snails significantly altered by in vivo exposure of *Lymnaea acuminata* to thymol and proven active molluscicidal²⁸.

Trachyspermum ammi also had significant protease activity²⁹. Ajowan also enhanced activity of pancreatic lipase and amylase, which may support its digestive stimulant activity³⁰.

Gastro protective activity

Its digestive stimulant action exerted by produced a significant shortening of the food transit time. *Helicobacter pylori* cause pathogenesis of peptic ulcer and gastric cancer. Ethanolic extract of *Trachyspermum ammi* exhibited anti-bacterial effect against various strains of *Helicobacter pylori* hence produced gastro protective activity³¹.

Abortifacient and galactogogic actions

There was a high risk of potential human foetus toxicity of *T. ammi*, based on teratogenicity observed in rat foetuses³². *T. 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)³³.

Hypolipidaemic action in vivo

It was observed that *T. ammi* powder at dose rate of 2 g/kg body were extensively effective lipid lowering action by decreased total cholesterol, LDL-cholesterol, triglycerides, total lipids³⁴.

Ajowan extract prevented the CCl₄-induced hepatotoxicity and it normalise the high serum levels of liver enzymes caused by CCl₄-induced liver damage in rats³⁵.

Antihypertensive, antispasmodic and broncho-dilating activity

The antihypertensive effect of *T. ammi* administered intravenously in vivo, and the antispasmodic and broncho-dilating actions in vitro have been evaluated. The studied of calcium channel blockade that has been found to mediate the spasmolytic effects and this property proved that this mechanism contributed to their hyperactive disease states of the gut such as colic and diarrhoea as well as in hypertension³⁵.

Detoxification of aflatoxins

Significant levels of degradation of aflatoxin viz., G1 (AFG1) AFB1, AFB2 and AFG2 by the dialyzed seeds extract was also observed³⁶.

CONCLUSION

It is concluded that medicinal plants have contributed hugely to the traditional and western medicines through providing ingredients for drugs or having played central roles drug development. The above review provides the update information regarding the *Trachyspermum ammi*. Essential oils of *T. ammi* exhibited good antibacterial, antifungal, insecticidal and anthelmintics activities. All are the essential oil of the seeds of *T. ammi* has gastro protective, hepatoprotective and analgesic potential and drugs used for the treatment of gastric disorder.

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