Journal of Science Research International (JSRI)
ISSN: 2456-6365 (Online)

OPEN ACCESS

TRACHYSPERMUM AMMI: A VALUABLE HERB WITH NUTRACEUTICAL AND PHARMACOLOGICAL SIGNIFICANCE

Soumya S.*, Devu R. and Sumayya A. S.

Department of Biochemistry,

T. K. M. College of Arts and Science, Kollam-691005, Kerala, India

**Corresponding author E-mail: soumyabiochemistry@tkmcas.ac.in*

Received: 07 May 2026	Revised: 10 June 2026	Accepted: 12 July 2026	Published: 30 July 2026

DOI: https://doi.org/10.5281/zenodo.21835400

Abstract:

Trachyspermum ammi (L.), commonly known as ajwain, is an important medicinal plant belonging to the family Apiaceae. It is widely cultivated in India, Iran, Pakistan, Egypt, and other regions and has long been used in traditional medicine to treat various ailments. The seeds of T. ammi are rich in essential oils, particularly thymol, which is responsible for its characteristic aroma and therapeutic properties. Traditionally, T. ammi has been used to manage gastrointestinal disorders such as indigestion, flatulence, dyspepsia, and diarrhea, as well as respiratory conditions including asthma, bronchitis, and cough. The plant exhibits diverse pharmacological activities such as antimicrobial, antioxidant, anti-inflammatory, antispasmodic, antihypertensive, hypolipidemic, antiplatelet, and bronchodilatory effects. Phytochemical investigations reveal the presence of bioactive compounds including thymol, carvacrol, γ-terpinene, p-cymene, flavonoids, tannins, saponins, and essential oils. These phytoconstituents contribute significantly to its therapeutic potential. In addition to medicinal uses, T. ammi is widely employed in food processing as a spice, flavoring agent, and natural preservative. The wide spectrum of pharmacological properties and bioactive compounds supports the traditional uses of T. ammi and highlights its importance as a promising source of phytopharmaceuticals and nutraceuticals.

Keywords: *Trachyspermum ammi, Apiaceae, Phytochemicals, Pharmacological Activities.*

Introduction

Since ancient times, plants have been widely used for a range of applications, including medicines, dyes, essential oils, cosmetics, and many other purposes. They continue to serve as a rich source of natural products and remain indispensable to pharmaceutical research, contributing significantly to the discovery and development of novel therapeutic agents. The search for effective therapeutics derived from natural products has become a major focus of contemporary pharmaceutical research. Medicinal plants and their secondary metabolites represent valuable sources of novel bioactive compounds with the potential to prevent and treat a wide range of diseases. In contrast,

synthetic drugs are often associated with limitations such as restricted accessibility, adverse side effects, and high treatment costs. Consequently, there has been a growing interest in natural product-based therapeutics, resulting in an increased reliance on herbal medicines for healthcare and disease management (1). Herbal medicines have achieved increasing attraction due to their wider therapeutic range, minimal side effects, and affordability (2).

Trachyspermum ammi (*T. ammi*), commonly known as ajwain, is an aromatic herbaceous plant indigenous to Egypt and widely cultivated in several countries, including Iran, Pakistan, Iraq, Afghanistan, and India. In India, the plant is grown extensively, particularly in Gujarat, Maharashtra, Uttar Pradesh, Bihar, and West Bengal. *T. ammi* is well adapted to arid and semi-arid regions and thrives in saline soils. The seeds of *Trachyspermum ammi* are a rich source of essential oil, characterized by a brownish color, with thymol (50.1%) as the predominant constituent. Other major volatile components include α-pinene, β-pinene, γ-terpinene, α-terpinene, and p-cymene (3). In addition to its volatile constituents, *T. ammi* contains carbohydrates (24.6%), fats (21.1%), proteins (17.1%), dietary fiber (11.9%), tannins, glycosides, saponins, flavonoids, and essential minerals such as calcium, phosphorus, iron, cobalt, copper, iodine, and manganese. It is also a source of vitamins, including thiamine, riboflavin, and nicotinic acid (4). *T. ammi* has been used in traditional medicine for centuries to treat a variety of ailments in both humans and animals. It is particularly valued for the management of gastrointestinal disorders, including diarrhea, flatulence, and dyspepsia (5). The seeds possess a characteristic pungent and slightly bitter taste and exhibit several pharmacological properties, including laxative, carminative, stomachic, and anthelmintic activities. Furthermore, they have been traditionally employed in the treatment of abdominal pain, abdominal tumors, and hemorrhoids, while modern studies have demonstrated their potent antioxidant and anti-inflammatory activities (6).

Trachyspermum ammi has been used extensively in the traditional Ayurvedic and Unani systems of medicine for centuries to treat a wide range of ailments and enhance the body's natural resistance to disease. According to Ayurvedic principles, ajwain helps balance the Vata and Kapha doshas while stimulating Pitta, thereby promoting overall physiological homeostasis. Traditionally, it has been incorporated into various herbal formulations to restore and maintain systemic balance. Owing to its remarkable therapeutic potential, *T. ammi* has been used to manage respiratory, cardiovascular, neurological, hepatic, splenic, and gastrointestinal disorders. In addition, it exhibits antipyretic, analgesic, anti-inflammatory, and detoxifying properties. Chewing ajwain seeds has been traditionally recommended for the relief of gastrointestinal complaints, including nausea, vomiting, indigestion, diarrhea, dysentery, abdominal cramps, spasmodic disorders, and loss of appetite (7).

The seeds yield a brown-colored essential oil (approximately 2–4.4%), with thymol as its principal constituent. This essential oil is widely used for the management of bronchial ailments, gastrointestinal disorders, and loss of appetite due to its well-established therapeutic properties (6). The present review provides a comprehensive overview of the pharmacological properties of *T. ammi*.

Vernacular names

- **English:** Ajwain, Bishop's weed
- **Hindi:** Ajwain
- **Malayalam:** Ayamodakam
- **Tamil:** Omam
- **Telugu:** Vamu

- **Sanskrit:** Yavani
- **Arabic:** Kamun Mulki
- **Persian:** Nankhah

Taxonomical classification

Taxonomic rank	**Name**
Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Apiales
Family	*Apiaceae*
Genus	*Trachyspermum*
Species	*T. ammi*

Botanical description

Trachyspermum ammi is an annual herbaceous plant that grows up to 60–90 cm in height. The plant possesses a branched stem with pinnate leaves and small white flowers arranged in umbels. The fruits are small, oval, grayish-brown seeds with a characteristic aromatic odor and pungent taste. Figure 1 depicts the flowers and seeds of *T. ammi*.

Figure 1: A. Flower of *T. ammi* **B. Seeds of *T. ammi***

The plant thrives in arid and semi-arid regions characterized by high levels of soil salinity. It is typically cultivated during the winter season and harvested in summer (8).

Traditional uses

T. ammi, an ancient remedy in Ayurvedic and Persian medicine, has been utilized for centuries. Its oil is known for various medicinal applications such as addressing bronchial issues, gastrointestinal troubles, and loss of appetite. The roots possess diuretic properties while the seeds exhibit aphrodisiac qualities. The oil's composition includes thymol (35%–60%), which is effective against bronchial problems, poor appetite, and gastrointestinal disorders. Thymol is also utilized in toothpaste and fragrances. Additionally, the oil showcases anti-aggregatory and anti-microbial properties in humans. The fruit of *T. ammi* has carminative, antispasmodic, and stimulating effects.

Phytochemical constituents

The seeds of *T. ammi* contain a wide range of bioactive compounds, including:

- Essential oils (2–5%)
- Thymol (major component)
- Carvacrol
- γ-terpinene
- p-cymene
- Flavonoids
- Tannins
- Saponins
- Glycosides

These phytoconstituents are responsible for the plant's pharmacological activities.

Pharmacological activities

Antioxidant activity

The antioxidant properties of *T. ammi*, attributed to its phenolic compounds and flavonoids, enable it to effectively scavenge free radicals and mitigate oxidative stress within the body. Such attributes have the possibility to inhibit cellular damage and decrease the likelihood of developing a range of chronic ailments (9). The ethanolic seed extract of *Trachyspermum ammi* exhibited strong antioxidant and free radical scavenging activity, along with significant inhibition of lipid peroxidation. These effects were attributed to its phenolic constituents, highlighting *T. ammi* as a potent natural source of antioxidants effective against oxidative stress (10).

The ethanol extract derived from *T. ammi* oil demonstrated robust antioxidant capabilities across various scavenging models, including DPPH, NO, and hydroxyl radical scavenging, as well as lipid peroxidation capacity in bovine extract. The ethanolic extract revealed a decline in control capacity while displaying significant efficacy in ferric ion reduction. These findings collectively affirm the pharmacological likelihood of *T. ammi* as a promising antioxidant source (11).

Antihyperlipidemic activity

An *in vivo* investigation demonstrated that the seed powder of *T. ammi* possesses significant antihyperlipidemic properties in albino rabbits. The study revealed that the powder effectively modulates lipid profile, notably reducing total cholesterol, triglycerides, and lipids by 71%, 63%, 53%, and 49%, respectively. Specifically, at a concentration of 2 g/kg, *T. ammi* seed powder significantly decreased key lipid profile indicators, including total lipids to 135 mmol/L, triglycerides to 120 mmol/L and 135 mmol/L, total cholesterol, and LDL cholesterol to 105 mmol/L, 120 mmol/L, and 150 mmol/L, respectively. Furthermore, organic seed extract demonstrated a reduction in the atherogenesis index and an increase in HDL cholesterol levels in albino rabbits (12).

Hypolipidemic activity

Several studies suggest that *T. ammi* may help reduce lipid levels in the bloodstream, including cholesterol and triglycerides. This potential effect could be advantageous in mitigating the hazard of cardiovascular diseases. *T. ammi* demonstrated a notable decrease in triglycerides, TC, LDL, and VLDL levels, accompanied by a significant increase in high-density lipoprotein (HDL) levels. This resulted in a modification of hepatic fat content and serum lipids, suggesting a protective role against hyperlipidemia, coupled with a beneficial antioxidant effect (13).

Anti-inflammatory activity

The potential anti-inflammatory effects of *T. ammi* may stem from its capacity to inhibit inflammatory mediators and enzymes, offering relief for inflammation associated with ailments such as arthritis, gastritis, and other inflammatory disorders. When 500 and 1000 mg/kg were administered to Wistar rats, and the anti-inflammatory effect was measured, the n-hexane extract showed a stronger anti-inflammatory effect at the maximum effective dose of 1000 mg/kg. *T. ammi* seed extract showed anti-inflammatory effects through GABA neurotransmission and glutamate receptor suppression (14).

Bahuguna *et al.* (15) reported that *Trachyspermum ammi* essential oil (TAEO) exhibits strong anti-inflammatory activity in lipopolysaccharide-stimulated RAW 264.7 macrophages. TAEO effectively reduced nitric oxide production and downregulated key inflammatory markers. Molecular docking further indicated that the major constituents thymol and carvacrol have strong binding interactions with COX-2, supporting their contribution to the observed anti-inflammatory effects (15).

Hepatoprotective activity

In *in vivo* studies, *T. ammi* seeds have shown an 80% hepatoprotective effect in mice given a paracetamol dose of 1 g/kg and have been effective in preventing the elevation of liver enzymes induced by CCl_4-induced liver damage in rats. Induced extension of pentobarbital sleep time in mice that tended to normalize serum levels. In addition to balancing hepatic enzyme levels, alkaline phosphatase levels, and aminotransferases (AST and ALT) during liver damage (16). *T. ammi* essential oil can protect the liver against CCl_4-induced hepatocellular injuries in mice at high dose due to its ability to scavenge free radicals and inhibit lipid peroxidation (17).

Insecticidal activity

Essential oils derived from *T. ammi* seeds exhibited pesticidal properties, particularly against the bean weevil *Callosobruchus chinensis*, affecting its egg-laying phase, as well as disrupting the development of the eggs and exhibiting inhibitory effects (18). Essential oils of *T. ammi* and *M. arvensis* oils inhibited progeny production by inhibiting oviposition in *S. zeamais* adults when exposed to sub-lethal concentrations (19).

Anti-ulcer activity

The ethanol extract from *T. ammi* seeds was found to significantly reduce the ulcer index in animals that received pre-treatment. It provided ulcer protection across various models. The findings indicate that the extract provided substantial protection by reducing the number of ulcerative lesions compared with the untreated control group in the study's animal model (20).

Antibacterial activity

Using an agar diffusion assay, *T. ammi* methanol, ethanol and acetone extracts were assessed against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Bacillus cereus*. In comparison to methanolic and acetonic extracts, ethanolic extract of *T. ammi* seeds showed a highest antibacterial activity against *P. aeruginosa*, *K. pneumoniae*, and *B. cereus*. Methanolic extract, on the other hand, effectively inhibited *S. aureus* and *E. coli*. The maximum inhibition zone in ethanolic was observed against *P. aeruginosa* and *B. cereus* (22.6 mm) and the minimum inhibition zone against *E. coli* (12 mm) at 100% concentration (21).

Wound healing activity

The antibacterial effect of *T. ammi* was studied by applying a cream containing 5% essential oil cream of *T. ammi* to a wound in rabbits and comparing its effect with that of an iodine solution. Wound contraction on the 15th day

in the *T. ammi* group was 99.68%, compared with the healing effect of the iodine solution group and the non-treatment group, which was determined to be 100% and 96.57%, respectively, which indicated a wound healing result of *T. ammi* (16). Silver nanoparticles synthesised from *T. ammi* act as a potent antibacterial agent that could inhibit biofilm formation and able to treat deep wounds without any scar marks (22).

Anthelmintic activity

The deworming effect of *T. ammi* is linked to its disruption of parasites' energy metabolism by increasing ATPase activity, thereby depleting their energy stores. This activity has been observed against particular helminths such as *Ascaris lumbricoides* in humans and *Haemonchus contortus* in sheep. Additionally, *T. ammi* is noted for its cholinergic effects, which stimulate peristaltic movements in the gut, aiding in the expulsion of intestinal parasites. This aspect may also contribute to its anthelmintic efficacy (23). Alcoholic and aqueous extracts of seeds of *Trachyspermum ammi* showed good anthelmintic activity against Indian earthworm *Pheretima posthuma* (24).

Gastro protective activity

Helicobacter pylori is implicated in the growth of peptic ulcers and gastric cancer. The ethanolic extract of *T. ammi* demonstrated antibacterial activity against various strains of *Helicobacter pylori*, thereby exhibiting gastroprotective effects (25). Thymol present in the essential oil of *Trachyspermum ammi* fruits can be used as a natural remedy for treatment of gastric ulcer by means of H^+/K^+ ATPase inhibition (26).

Hypoglycemic activity

Research suggests that *T. ammi*, commonly known as carom seeds, may lower glucose levels, benefiting those with diabetes or at risk for it. The antidiabetic properties of *T. ammi* could stem from its ability to inhibit α-amylase enzyme activity and improve glucose uptake in fat and muscle tissues (27).

Antiplatelet activity

T. ammi might exhibit antiplatelet characteristics, potentially aiding in the prevention of abnormal blood clotting and lowering the likelihood of thrombotic incidents like heart attacks and strokes. The extract hindered platelet aggregation prompted by arachidonic acid, collagen, and epinephrine by modifying the arachidonic acid pathway and diminishing collagen formation (28).

Conclusion

Trachyspermum ammi stands out as a highly valuable medicinal plant enriched with diverse phytochemicals that contribute to its wide spectrum of therapeutic properties. Across multiple studies, its antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities have been consistently demonstrated through both traditional and modern scientific approaches. The presence of bioactive compounds such as thymol, γ-terpinene, and various phenolics supports its effectiveness in managing conditions related to oxidative stress, inflammation, metabolic disorders, and microbial infections. Overall, *T. ammi* holds significant promise as a natural, safe, and multipurpose medicinal agent, offering substantial potential for future development in herbal medicine, pharmaceutical applications, and nanotechnology-based drug delivery systems.

References

1. Jaishwal, N., Jayswal, M., Gupta, D. C., Dhakal, B., Koirala, S., Khadka, R. B., Devkota, H. P., & Pandey, J. (2025). Bioactive potential of *Pogostemon benghalensis* (Burm. f.) kuntze: antibacterial, antioxidant, and xanthine oxidase inhibitory activities. *Bacteria*, 4(1), 3.
2. Ahmed, S. N., Ahmad, M., Zafar, M., Yaseen, G., Iqbal, N., Rashid, N., Kousar, S., & Haroon, A. (2023). Herbal

drugs: safety, cost-effectiveness, regulation, current trends, and future directions. In *Bioprospecting of tropical medicinal plants* (pp. 1479–1493). Springer.

3. Goyal, S., Chaturvedi, V., Dhingra, G., Tanwar, S., Sharma, K., & Singh, S. (2022). *Trachyspermum ammi*: A review on traditional and modern pharmacological aspects. *Biological Sciences*, 02, 324–327.
4. Zarshenas, M. M., Moein, M., Mohammadi-Samani, S., & Petramfar, P. (2014). An Overview on Ajwain (*Trachyspermum ammi*) Pharmacological Effects; Modern and Traditional. *Journal of Natural Remedies*, 14, 98–105.
5. Ramchander, P. J., & Middha, A. (2017). Journal of Medicinal Plants, 5(3), 16–22.
6. Bairwa, R., Sodha, R. S., & Rajawat, B. S. (2012). *Trachyspermum ammi*. *Pharmacognosy Reviews*, 6(11), 56.
7. Ranjan, B., Singhal, M., Singh, S., Singh, R., & Tiwari, D. A. (2011). Medicinal uses of *Trachyspermum ammi*: A review. *Pharma Research*, 5.
8. Siddiquie, F., Ahsan, F., Mahmood, T., Ahmad, M., Singh, A., & Bano, S. (2024). Unlocking the food treasures: *Trachyspermum ammi*–A comprehensive exploration from field to pharmacology. *Food Safety and Health*, 2.
9. Raza, M., Shukla, A. K., Fatima, T., & Ali, S. (2015). Comparative study of antioxidant activity of polyphenols isolated from frozen and fresh leaves of *Trachyspermum ammi* (Ajwain). *Journal of Pharmacognosy and Phytochemistry*, 3(6), 122–124.
10. Bajpai, V. K., & Agrawal, P. (2015). Studies on Phytochemicals, Antioxidant, Free Radical Scavenging and Lipid Peroxidation Inhibitory effects of *Trachyspermum ammi* seeds. *Indian Journal of Pharmaceutical Education and Research*, 49(1).
11. Sahukari, R., Punabaka, J., Yamala, P. K., Bhasha, S., Subbaiah Ganjikunta, V., & Kesireddy, S. R. (2020). Potential Antioxidant and Antibacterial Properties of Medicinal Plant *Trachyspermum ammi* L. Seeds. *Free Radicals & Antioxidants*, 10(2).
12. Javed, I., Iqbal, Z., Rahman, Z. U., Khan, F. H., Muhammad, F., Aslam, B., & Ali, L. (2006). Comparative antihyperlipidaemic efficacy of *Trachyspermum ammi* extracts in albino rabbits. *Pakistan Veterinary Journal*, 26(1), 23.
13. Saleem, U., Riaz, S., Ahmad, B., & Saleem, M. (2017). Pharmacological screening of *Trachyspermum ammi* for antihyperlipidemic activity in Triton X-100 induced hyperlipidemia rat model. *Pharmacognosy Research*, 9(Suppl 1), S34.
14. Aslam, A., Nokhala, A., Peerzada, S., Ahmed, S., Khan, T., & Siddiqui, M. J. (2020). Evaluation and comparison of *Trachyspermum ammi* seed extract for its anti-inflammatory effect. *Journal of Pharmacy and Bioallied Sciences*, 12(Suppl 2), S777–S780.
15. Bahuguna, A., Ramalingam, S., Arumugam, A., Natarajan, D., & Kim, M. (2020). Molecular and *in silico* evidences explain the anti-inflammatory effect of *Trachyspermum ammi* essential oil in lipopolysaccharide induced macrophages. *Process Biochemistry*, 96, 138–145.
16. Gilani, A. H., Jabeen, Q., Ghayur, M. N., Janbaz, K. H., & Akhtar, M. S. (2005). Studies on the antihypertensive, antispasmodic, bronchodilator and hepatoprotective activities of the *Carum copticum* seed extract. *Journal of Ethnopharmacology*, 98(1–2), 127–135.
17. Zangeneh, M. M., Farzaei, M. H., Goodarzi, N., & Zangeneh, A. (2018). Protection of CCl_4 -induced

hepatotoxicity by *Trachyspermum ammi* essential oil in mice. *Comparative Clinical Pathology*, 27(5), 1367–1374.

18. Chaubey, M. K. (2008). Study of insecticidal properties of *Trachyspermum ammi* and *Mentha arvensis* essential oils against *Callosobruchus chinensis*.
19. Chaubey, M. K. (2018). Study of insecticidal properties of *Trachyspermum ammi* and *Mentha arvensis* essential oils against *Sitophilus zeamais* L. (Coleoptera: Curculionidae). *Curr Life Sci*, 4, 10–17.
20. Panda, P., Valla, S., Lakshmi, M., Harika, C., & Bhadra, P. (2020). An Overview of Ajwain (*Trachyspermum ammi*).
21. Bashyal, S., & Guha, A. (2018). Evaluation of *Trachyspermum ammi* seeds for antimicrobial activity and phytochemical analysis. *Evaluation*, 11(5), 148–222.
22. Saxena, N., Jain, S., Roy, M., Nimesh, S., Chatterjee, S., & Gupta, N. (2025). *Trachyspermum ammi* seed extract modulated nanosilver as a transformative agent for antibacterial and wound healing activities. *International Journal of Modern Physics B*, 39(17), 2550147.
23. Jabbar, A., Iqbal, Z., & Nisar Khan, M. (2006). *In vitro* anthelmintic activity of *Trachyspermum ammi* seeds. *Pharmacognosy Magazine*, 2, 126–129.
24. Apte, A. K., Khot, V. S., Biradar, N. S., & Patil, S. B. (2014). Academic Sciences, 6, 19–21.
25. Zaidi, S. F., Yamada, K., Kadowaki, M., Usmanghani, K., & Sugiyama, T. (2009). Bactericidal activity of medicinal plants, employed in the Pakistani traditional system of medicine, against *Helicobacter pylori*. *Journal of Ethnopharmacology*, 121(2), 286–291.
26. Eftekhari, M., Hoseinsalari, A., Mansourian, M., Farjadmand, F., Shams Ardekani, M. R., Sharifzadeh, M., Hassanzadeh, G., Khanavi, M., & Gholami, M. (2019). *Trachyspermum ammi* (L.) Sprague, superb essential oil and its major components on peptic ulcers: *in vivo* combined *in silico* studies. *Daru: Journal of Faculty of Pharmacy, Tehran University of Medical Sciences*, 27(1), 317–327.
27. Amar, G., & Kuppusamy, A. (2022). *In-vitro* Study of *Trachyspermum ammi* extract against diabetes mellitus. *Trends in Sciences*, 19(16), 5698.
28. Asif, H. M., Sultana, S., & Akhtar, N. (2014). A panoramic view on phytochemical, nutritional, ethanobotanical uses and pharmacological values of *Trachyspermum ammi* Linn. *Asian Pacific Journal of Tropical Biomedicine*, 4, S545–S553.