WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 13, Issue 3, 535-549. Review Article ISSN 2277–7105

AJWAIN [TRACHYSPERMUM *AMMI* (LINN.)]: AN EVIDENCE-BASED REVIEW ON ITS PHYTOCHEMICAL ASPECT, ETHNOPHARMACOLOGY, THERAPEUTIC POTENTIAL AND ITS DERMATOLOGICAL BENEFITS

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Article Received on
12 December 2023,

Revised on 02 Jan. 2024,
Accepted on 23 Jan. 2024

DOI: 10.20959/wjpr20243-31161

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ABSTRACT

Background: The Umbelliferae family, which includes the well-known Unani plant Ajwain, is found in tropical Africa, the Mediterranean region, South-West Asian countries, India, and West China. Ajwain has long been used in Unani medicine to treat conditions related to the digestive system, the respiratory system, neurological illnesses, hepatic and genitourinary disorders. Using a variety of electronic databases, including as Pub Med, Web of Science, Science Direct, Elsevier, Google Scholar, and others, a thorough review of the literature on Ajwain has been done. Books like Azam Khan's Muheet e Azam, Khazainul Advia of Najmul Ghani, Hakim Abdul Hakeem's Bustanul Mufradat, Hakim Kabeer-ud-din's Ikseere Azam, and Abu Alhassan Ali Ibne-e Abbas's Kamil Sanaa were also consulted. Using the Glossary of Indian Medicinal Plants and a number of indexed publications, a comprehensive analysis of the botanical and English names of medicinal plants was carried out (Chopra et al., 1956). The results showed that the plant possesses a wide range of pharmacological properties, including digestive, anti-cancer, anti-inflammatory, antifungal, anti-bacterial, and estrogenic effects. These properties are likely caused by the presence of aromatic compounds like thymol, carvone, limonene, dillapiole, hygroscopic saponin, and crystalline flavone.

Because of its many pharmacological qualities and significance to human health, Trachyspermum *ammi* is potentially useful in the creation of a variety of drugs.

1. INTRODUCTION

In both developed and developing nations, medicinal herbs have gained popularity in recent years.[1] Around 80% of people on Earth (including 90% of Member States in the Eastern Mediterranean, South-East Asian, and Western Pacific regions) use various medicinal plants for health purposes, according to latest estimates from the World Health Organization (WHO).[2] Unani drugs are categorised on the basis of their origin (Mahiyat).[3] *Trachyspermum ammi* (Ajwain) is one of the plant-origin drugs, well-known spice widely used in Unani System of medicine for various diseases. It has been used for *Amraze Medi* (Gastrointestinal disorders), *AmrazeJild* (Skin Disorders), *AmrazeKabid* (Liver disorders), *Amraze Darde Seena* (Respiratory disorders) *Amraze gurdah* (Kidney disorders) in Unani system of medicine.[5] Originating in Egypt, Trachyspermum ammi is found throughout tropical Africa, the Mediterranean region, and eastward through South-West Asian nations to India and West China. This fragrant annual plant is a member of the Umbelliferae family, which gets its name from the Greek words "Trachy" (meaning "rough") and "spermum" (meaning "seeded"). The Latin name for the plant is "ammi."[4]

Vernacular Names

Scientific Name; Trachyspermum ammi (L.) and Sprague[5],

Hindi - Ajwain, Ajowan[5]

Kashmiri - Jawind[5]

English- Bishop's weed.[6]

Bengali-Jain[7]

Persian -Nankhwah[8]

Arabic -Kamun –e- maluki[9]

Taxonomy, Distribution, Cultivation and Ethnopharmacological aspects.

Table 1: Ajowan Classification.[10]

Kingdom	**Plantae**
Subkingdom	Tracheobionota
Division	Magnoliophyta
Class	Magnoliosida
Order	Apiales
Family	Apiacae

Genus	Trachyspermum
Species	Ammi

Distribution and Habitat

Trachyspermum ammi Linn. is widely grown in Egypt, Iran, Pakistan, Afghanistan, India, and the European region are among the places where it increases most rapidly.[11] The majority of its production takes place in India; Madhya Pradesh, Andhra Pradesh, Gujrat, Maharashtra, and Uttar Pradesh are the key growing states; Rajashtan, Bihar, and West Bengal also produce a sizable amount of it.[5] The planting season for irrigated garden crops runs from September to November in various sections of the nation. February and March are the harvesting months. Grown as a dry crop, AJWAIN is planted in areas of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, and Mysore that have black cotton soils. The planting season in Madhya Pradesh runs from July to August, while the harvesting season is from December to January. In North India's plains, seeds are sown in October and November and harvested by the end of March. The crop in Punjab is sown in October or November and harvested in April or May.[5]

Macroscopic Description

A smooth, erect herb that grows to a height of one to three feet. The stem is branching and striated. The inflorescence is a compound umbel consisting of 16 umbels, each holding up to 16 white flowers with bilobed petals, five stamens, an inferior ovary, and a corolla. The fruits are ovoid, muricate, aromatic cremocarps, 2–3 mm long, greyish brown, with pronounced ridges; the mericarps are compressed, possessing a tubercular surface and one seed. The leaves are somewhat distant, with two to three pinnate divisions.[5]

MICROSCOPIC DESCRIPTION

The T. ammi fruit's transverse section revealed two hexagonal structures joined by a carpophores; in the epicarp, there is a single layer of tangentially elongated tabular cells; in the mesocarp tissues, there are rectangular, somewhat thick-walled, tangentially elongated cells with some vittae, integument, and barrel-shaped cells; in the endosperm, there are thin-walled cells filled with embryos and oil globules, which are small and circular and made of polygonal thin-walled cells. The powder's microscopic features showed that endosperm cell clusters and oil globules were present.[12,13]

Unani description

TEMPERAMENT (*Mizaj*): Ajwain's temperament can be described as hot and dry in the third degree, with hints of bitterness and acridity. 3 Hot 3 Dry 3[14][15]

DOSE: 3-5 gm[14] to10.5 gm[15]

Parts use: Trees, roots and seeds are used.

Color: Ajwain seeds are brown in color.

Reaction: Excessive consumption of Jain is harmful for person with hot in nature and causes headaches.[16]

Representatives: Nigella sativa[17]

Adulteration

There are whole and ground T. ammi seeds available. Excess stems, chaff, dirt, or dust are used to adulterate spent seed (from which oil or oleoresin has been extracted). Ajowan chaff oil is used to adulterate oil; its essential oil content should be between 2% and 4%, and its thymol content should be between 35% and 60%. The thymol concentration will drop to less than 35% in addition to the chaff oil. Gas chromatography or thin-layer chromatography combined with high-performance liquid chromatography can be used to detect these adulterants. Ban ajwain [Seselidiffusum (Roxb. ex. Sm.)] and randhuni [Apium graveolens (Linn.) Sprague] are the most common adulterants of Ajwain seeds. For detection of adulteration thin layer chromatography using benzene: petrol (1:7) is done.[18]

Phytochemistry

Fiber (11.9%), carbohydrates (38.6%), tannins, glycosides, moisture (8.9%), protein (15.4%), fat (18.1%), saponins, flavones, and mineral matter (7.1%) such as calcium, phosphorus, iron, and nicotinic acid are all present in T. ammi seeds, according to analysis. Thymol (35%–60%) is the main component of the essential oil found in ajwain (2.5%–5.0%). Thymene,

which refers to the remaining non-thymol fractions, comprises p-cymene (50–55%), β-pinene (4%–5%), limonene including γ-pinenes, and β-pinene (30–35%).Contains very hygroscopic saponin in alcoholic extract. It hasbeen reported that small amount of camphene, myrcene and D3-carene is also present. A yellow crystalline flavone and steroid like substance have been isolated from the fruit of *Ajwain* and it also contains a glucoside 6-O-β-glucopyranosyloxythymol. The major constituents of *T. ammi* are carvone (48%), limonene (38%) and dillapiole (9%).[19] Vitamins like Thiamine (0.21 mg/100gm), Riboflavin (0.28 mg/100gm), Nicotinic acid (2.1 mg/100g) and Carotene (71 mcg/100g).[20]

Nutritional value

T. ammi seeds have a greater calorie content (314.55%) and a high carbohydrate content (47.54%). The levels of protein, moisture, ash, and fiber varied from 4.30% to 20.23%, whereas the contents of fat were between 4.83% and 4.30%.[21] Based on its nutritional value, it is thought that Ajwain, when used as a spice in a person's diet, supplies enough energy, proteins, and carbs. Its biologically active components have been shown to increase the food's nutritional content and so be potential sources of beneficial foods.[22]

Traditional use

According to literature review the plant is commonly used for its pharmacological actions like *Muddir –e-bau l*(Diuretic)[15], *Sailan-ur-Reham* (Leucorrhea)[23], *Iltihab-e- Sadain* (Mastitis)[24], *Muarriq* (Perspiratory), *Hisat-e-kulliya (Lithotriptic*), *Muhallil(Anti - inflammatory*), *Deedan-e-Ama (Intestinal Worms*), *Daf-e-taffun (Antiseptic), Tiryaq (Antidote)), Muddir-e-Haiz* (Emmenagogue), *Istisqa(Ascites), Usrulbaul (Dysuria))*[10], *Dard-e- seena*(Respiratory disorders), *Muffatit-e sudad (Deobstruent)*), Muqawwi Bah (Aphrodisiac), *Bars wa Behak (Vitiligo&Pityriasis), Mahasai* (Acne), *Bruises*[15], *Falij* (Paralysis)[15], *Badhazmi* (Dyspepsia).[15] Diarrohea, Skin diseases, Colic, Epilepsy, Intestinal worms, Gastroprotective, Cough, Amenorrhoea, Obesity, Galactagogue, Epilepsy, Neuralgic pain, Dental caries[25]

Pharmacological actions

Antispasmodic, antiseptic, antibacterial, antifungal[5], antihypertensive[15,26], anti-platelet[27], antiinflammatory[28],antioxidant[29], antiplatelet[30], detoxificant[31]antiviral[32], estrogenic[33] anthelminthic[34], spermicidal[35], antiulcer[36], bronchodilatory[37] and aphrodisiac, cardio-depressant, carmi native, diaphoretic, diuretic, emmenagogue, expectorant, gastro relaxant,

gastro-stimulant, hypotensive, lactagogue, laxative, litholytic, parasympathomimetic, sialagogue, spasmogenic, stimulant, stomachic, tonic and vermifuge.[10]

Antimicrobial Activities

Ajwain exhibits antimicrobial properties against a variety of microorganisms, including Varicella aureus, Salmonella typhosa, Escherichia coli, and Micrococcus pyogenes. Thymol, a phenol derived from Ajwain oil, has potent antibacterial qualities and a pleasant smell. It also helps with a number of skin fungal infections brought on by Candida albicans. It can be used as dusting powder, solutions, or ointments. It is also utilized in dentistry and numerous pharmaceutical preparations since it is a component of mouthwashes, tooth pastes, and gargles.[5]

Therapeutic Skin Benefits

In addition to their many other advantages, ajwain seeds are also thought to have skin-beneficial properties. Approximately 15% of an adult's entire body weight is made up of the skin, which is the biggest organ in the body.[38] The skin's essential roles include protecting the body from physical, chemical, and biological threats from the outside, preventing the body from losing too much water, and assisting with thermoregulation. The epidermis, dermis, and subcutaneous tissue are the three layers that make up the skin. The pigment melanin provides defence against ultraviolet light that can damage skin cells. Acne is the most prevalent skin condition. A variety of treatments are available for acne, including oral and topical antibiotics, topical retinoids, topical benzoyl peroxide, hormone therapy, isotretinoin, and procedural therapies like laser and light therapy. Healthcare professionals should be aware of any possible negative effects of these treatment modalities even if they all offer different benefits for managing acne.[39] These days, skin-related issues are extremely frequent, and people are concerned about them as well, especially women, who value having beautiful, healthy skin. Thus, in as many ways as are listed below, ajwain may be able to shield the skin from different illnesses and outside influences.

1) Acne

One of the most prevalent dermatological disorders is Acne vulgaris. Significant financial hardship and psychological suffering are linked to acne. A pilosebaceous unit inflammatory disease that is prevalent in adolescence.[40] Approximately 90% of teenagers suffer acne, and half of them still have symptoms as adults. Acne in youngsters is becoming more common, according to recent investigations[41] maybe as a result of pubertal onset. The anti-acne

therapies now on the market are not effective or secure. The safety and effectiveness of the essential oil of Trachyspermum ammi (Ajwain) fruits in a topical formulation (1% gel) for individuals with facial acne were investigated in this study. The fruit's essential oil was extracted using the hydrodistillation method and then combined into a 1% gel. Twenty individuals with mild to moderate acne received topical ajwain gel twice daily for eight weeks as part of an uncontrolled clinical experiment. The results of the red fluorescence parameters, biophysical skin profiles, and acne lesion count were assessed on the fourth and eighth week. Every patient finished the investigation. The mean reduction in the non-inflammatory (7.3±4.53; p=0.000) and overall (8.2±3.36; P=0.000) lesions was statistically significant two months following treatment. Additionally, there was a noticeable decrease in the number and size of red fluorescence patches. Measurements of the biophysical skin profile revealed a significant increase (p=0.005) in pH and a significant decrease (p=0.026) in erythema and sebum. The study's findings established the efficacy of topical gel in treating mild to moderate cases of face acne. Two months into the treatment, there was a decrease in non-inflammatory lesions. Furthermore, there was a reduction in the quantity and size of red fluorescence spots. Biophysical assessment also showed a decrease in sebum and erythema along with increase in pH.[42]

2) Wounds

A wound is a split in the skin's or tissues' integrity which often results in disturbance of structure and function[43], as the body attempts to heal the injured area.[44] A 2018 retrospective examination of Medicare beneficiaries revealed that nearly 8.2 million persons suffered wounds, either with or without infections.[45] The type of injury that caused the wounds, the timing (acute or chronic), and the extent of the damage to the skin and underlying tissues are the most crucial aspects in the evaluation process.[46] Ajwain is applied topically to heal skin infections and clean wounds. An investigation was conducted to assess the antibacterial efficacy of a cream that contained Trachyspermum ammi essential oil. The cream's ability to treat rabbit wounds was compared to that of iodine tincture. On the fifteenth day, there was 100% wound contraction in the iodine tincture group. Just 96.57% of wounds in the control group were healed. Conversely, the T Ammi cream group reported a wound contraction rate of 99.68%. The lack of edema and erythema suggests that the cream does not irritate skin. Cream had better wound-healing activity than the group under control.[47]

3) Urticaria/Shara

Wheals that arise suddenly and quickly are a hallmark of urticaria, and angioedema is also present.[48] The etiology of chronic urticaria is complex and includes immunological mechanisms, dietary or medication intolerances, and infectious diseases.[49] Ajwain eaten twice a day with treacle is reported to treat urticaria in a week, according to literature.[50] An investigation was conducted to determine Safoof-e-ajwain's effectiveness in treating shara, or urticaria. A clinical research with an open label was carried out on thirty participants. A baseline history was acquired, containing personal information, a description of the symptoms, and information on previous medical conditions. Following the collection of baseline data, a thorough clinical examination was conducted on each patient. During the initial appointment, the patients were examined for B.S.L. Random. For 45 days, the patients received 10.5 grams of safoof-e-ajwain orally. Every fifteen days, the patients were checked on. Thirty patients finished the study with favorable results out of the 37 that were enrolled, while seven patients were lost to follow-up. The Urticaria Assessment Score (UAS), a globally recognized technique for evaluating the effectiveness of test drugs in clinical studies for urticaria, was utilized to conduct a clinical assessment of the patients. The average UAS score at visit 1 was considerably greater than the UAS score at visit 2 (P-value<0.05). At visit 1, the average UAS score was substantially higher than the UAS score at visit 3 (P-value<0.001).

4) Vitiligo

Skin disease called vitiligo is an autoimmune condition that causes the skin's pigment cells, or melanocytes, to disappear. This leaves the skin, hair, and mucous membranes discolored in various places. The melanocytes' destruction and blockage of the melanin synthesis pathway can also be used to characterize vitiligo.[52,53] The typical lesion is a completely amelanotic, nonscaly, chalky-white macule with clear edges. Cursi Karwiya, also known as caraway tablets (CWT), is a popular traditional medicine formula used to cure vitiligo in Xinjiang, China. An investigation of the effects of CWT in vitro and in vivo was carried out using B16 cell line and animal models of vitiligo. Its mechanisms of regulating melanogenesis were also explored. A study came to the conclusion that CWT alleviated a great deal of the negative effects in both vitiligo models. Tyrosinase activity and melanin concentration were elevated in B16 cells, at least partially, as a result of activation of the PKA p38 MAPK signaling pathways. Based on the findings, CWT improved vitiligo characteristics and may be

investigated further for use in treating this debilitating autoimmune condition, for which there is presently no proven treatment.[54]

5) Bruises

The word "bruise" originates from the old English bruṣan, brīesan, which means "to bruise; crush." It is thought that a bruise is a skin injury that causes a skin discoloration due to localized bleeding caused by capillary damage, in which some blood leaks into the interstitial tissues surrounding the injury. Damaged blood cell pigment gathers beneath the skin's surface close to the surface, creating a black and blue mark.[55] A contusion typically results in severe swelling, subcutaneous tissue crushing or tearing, and usually no skin loss.[56] Ajwain combined with honey is applied topically to bruises, according to Unani literature.[57] There is a need to investigate bruises in more scientific studies.

6) Fungal Infection

A fungal infection, also known as a cutaneous or superficial mycosis, is caused by any number of fungi infecting a person's skin. Some fungal infections have minimal or nonexistent symptoms, like scaling, redness, and itching. Additional fungal infections result in extreme scaling, blistering, itching, and swelling. Healthcare professionals face a challenging task as the incidence of fungal diseases is rising quickly.[58] Their growth and multiplication are caused by environmental factors like warm, humid, and unsanitary circumstances.[59] Studies have shown that thymol, which is found in Ajwain, can be used as solutions, ointments, or dusting powders to treat a range of fungal skin infections.[5] The chemical makeup, toxicity, and antidermatophytic activity of Trachyspermum ammi essential oil were investigated in a study.[60] Antidermatophytic activity was evaluated by the minimal inhibitory concentration and disc diffusion method. Chrysosporiumtropicum (63.83±0.166 mm) showed the largest zone of inhibition, followed by Trichophytonsimii (57±0.288 mm), Trichophytonrubrum (51.33±0.333 mm), and Chrysosporiumindicum (45±0.577 mm).T. Ammi oil's minimum inhibitory concentration against test fungus varied from 0.025 to 0.5 µl/ml. T. Ammi oil was additionally put through Buchii's glass oven apparatus for fraction separation. Five fractions were identified as TAI-TAV and separated at varying temperatures. Maximum impacts were observed when TAIV and TAV fractions were included. Trichophytonrubrum (0.02±0.000 µl/ml), Microsporumcanis (0.017±0.002 µl/ml), Candida albicans (0.05±0.003 µl/ml), and Microsporumgypseum (0.015±0.002 µl/ml) were the next species to be identified to exhibit excellent TAV results. The investigation revealed that there

were no harmful side effects from low oil concentrations. Additionally, animals bedding on these materials would not have an acute skin irritation at the low concentration of T. ammi oil, nor would it cause hypersensitive reactions. When compared to conventional allopathic medications, T. ammi oil shown exceptional antidermatophytic action. Consequently, T. ammioil can be utilized as an alternative therapy to treat tinea or ringworm infections.[60] A second study assessed the ethanolic extract and hexanes fraction of Trachyspermum ammi (L.) Sprague seeds' antifungal efficacy against Candida albicans in both an in vitro and an in vivo setting. In sick and immunocompromised people, Candida albicans is the cause of candidiasis. When the extract and fraction containing ointment were topically administered to the flanks of BALB/c mice at different concentrations for the treatment of cutaneous candidiasis, mice showed 90–100% recovery, which was superior to the usual medication, clotrimazole. Therefore, it has been demonstrated that T. ammi has the potential to have an antifungal effect and, with more pre-clinical and clinical trials, may be utilized to the creation of novel antifungal medicines.[61]

7) Repellant activities

Ajwain seed essential oil and its component thymol, when tested for larvicidal, vapor toxicity, oviposition-deterrent, and repellant activities against Anopheles stephensi, demonstrated positive findings, per recent studies. Thymol was shown to have LD50 values of 48.88 and 80.77 µg/ml, respectively, making it 1.6 times more hazardous than oil to A. stephensi larvae in their fourth instar. When exposed to thymol vapors rather than T. ammi seed oil, female adults of A. stephensi were shown to lay considerably less eggs, and a similar effect was observed for subsequent egg hatching and larval survival. The results of the vapor toxicity assay indicated that the LC50 value of thymol against adult A. stephensi was 79.5 mg/mat, while the LC50 value of crude oil was 185.4 mg/mat. After one hour, it was discovered that thymol, at a dose of 25.0 mg/mat, completely repelled adult A. stephensi, whereas the oil, at a dose of 55.0 mg/mat, produced the same degree of repellency, showing that it had twice the activity of the oil.[62]

Drug interaction

In addition to skin advantages T.ammi has demonstrated several medication interactions that, when combined with the following medications, may raise the risk of bleeding and bruises: (ReoPro) antithrombin III, (thrombateIII) argatroban, abciximab, (ReoPro) antithrombin III, (thrombate III) argatroban, clopidogrel, (plavix) dalteparin,(argatroban) aspirin, (fragmin)

danaparoid, (orgaran) dipyridamole, (bufferin, ecotrin) aspirin and dipyridamole, (aggrenox) bivalirudin, (angiomax), (fragmin) danaparoid, (orgaran) dipyridamole, (novo-dipiradol, persantine) enoxaparin, (lovenox) eptifibatide, (hepalean, hep-lock) indobufen (ibustrin) (integrillin) fondaparinux, (arixtra) heparin.[63,64]

CONCLUSION

Trachyspermum ammi fruit, and essential oils have the ability to treat a variety of skin conditions According to Unani Physicians. But there are still some holes that need to be addressed, such as the basic mechanism of action, which has not yet been investigated. Thus yet, only few research have been conducted. Drug interactions in conventional therapy should be further investigated. Therefore, more investigation is required to determine the safety profile of crude extracts and the individual chemical components that give this herb its unique biological activity. Despite allopathic treatment's potential negative effects, the majority of skin conditions are gradually becoming more problematic for the medical system. Further scientific studies using the same therapeutic herb are crucial, nevertheless. As already stated, ajwain is a common spice that is practically always present in homes. Therefore, further research on it is necessary to help individuals by preventing disease and treating ailments.

REFERENCES

1. World Health Organization, 2010. Benchmarks for training in traditional /complementary and alternative medicine: benchmarks for training in Ayurveda. https://apps.who.int/iris/handle/10665/44352 (accessed 13 March 2021).
2. World Health Organization, 2019. WHO global report on traditional & complementary medicine. https://www.who.int/publications/i/item/978924151536 (accessed on 02 March 2021).
3. Hamdani, S.K.H., Usool -e tib. Qaumi Council BarayFirog Urdu Zabaan, New Delhi, 2011; 376–377.
4. Dwived SN, Mishra RP, Alava S. Phytochemistry, Pharmacologicalstudiesand Traditional benefits of Trachyspermumammi (Linn.) Sprague. Int. J. of Pharm. & Life Sci., May, 2012; 3(5): 1705.
5. Anonymous. The Wealth of India Raw Materials. VolX. Sp–W, New Delhi: CSIR; YNM; 267-71s.
6. Chopra R.N, Nayar S.L, ChopraI. C. Glossary of Indian medicinal plants, 1956.
7. Nadkarni. YNM.K.M, Indian plants and drugs with their medical properties and Uses.

8. Ibn-e Sina. Al QanoonFilTibb (Urdu translation by Kantoori GH). New Delhi: IdaraeKitabulShifa, 2: 157.
9. Abdul HM. BustanulMufradat. New Delhi: IdaraeKitabulShifa, 2011; 54-55.
10. Jan SA, Shinwari ZK, Zeb A, Khalil AT, Shah SH. Ethnobotany and Research Trends in Trachyspermumammi L. (Ajowan): A Popular Folklore Remedy. American-Eurasian J. Agric. & Environ. Sci., 2015; 15(1): 68-73.
11. BentlyRobert, Trimen Henry. Medicinal Plants. Asiatic Publishing House: Delhi.
12. Dwivedi SN, Mishra RP, Alava S. Phytochemistry, Pharmacological studies and Traditional benefits of Trachyspermumammi (Linn.) Sprague. Int. J. of Pharm. & Life Sci., May, 2012; 3(5): 1705.
13. B Ranjan, S Manmohan, SR Singh, RB SinghMedicinalusesof *Trachyspermumammi*:a reviewPharm Res., 2011; 5.
14. Rafeequddin M. KanzulAdviaMufridah. Aligarh: Muslim University Press; 1985; 73-4: 83-4.
15. Ghani HN.KhazainulAdvia. 2nd ed. New Delhi: IdaraeKitabulShifa; 2011; 202-3, 206-7, 226, 293.
16. Abbas A.I. KamilusSanaa. New Delhi: IdaraeKitabulShifa, 2010; 464.
17. Kabir-ud-din H.M. New Delhi : Ajaz Publishing House, 2010; 712.
18. B Chauhan, G Kumar, M AliA review on phytochemical constituents and activities of *Trachyspermumammi* (L.) Sprague fruitsAm J PharmTech Res., 2012; 2: 329-340
19. Asif HM, SultanaS, Akhtar N.A panoramic view on phytochemical, nutritional, ethno botanical usesand pharmacological values of TrachyspermumAmmi Linn.Asian Pac J Trop Biomed, 2014; 4(2): 545-53.
20. Khare C.P. Indian medicinal plants- An illustrated dictionary. New Delhi: Springer; 2007; 56-7, 486-7, 665, 674, 694.
21. Council of Scientific & Industrial Research (India), Publications & Information Directorate. The wealth of India: a dictionary of indian raw materials and industrial products publications and information directorate, Council of Scientific & Industrial Research, Publications & Information Directorate, New Delhi., 1990.
22. S Javed, AA Shahid, MS Haider, A Umeera, R Ahmad, S MushtaqNutritional, phytochemical potential andpharmacological evaluation of *Nigella sativa* (Kalonji) and *Trachyspermumammi* (Ajwain)
23. Qumari AMH. Ghana Mana (Urdu translation). New Delhi: CCRUM, 2008; 103, 369, 372-3, 386, 388-9, 391-2, 394-6, 410-13,417,423.

24. Abdul HM. BustanulMufradat. New Delhi: IdaraeKitabulShifa, 2002; 56-8: 66.
25. Khan S, ShameemI, Sahibole S, Siddiqui A. Trachyspermumammi: Ancient Unani Medicine for modern cure, A review of potential therapeutic applications. WJPR, 2016.
26. Bairwa R, Sodha RS, Rajawat BS.Trachyspermumammi. *Pharmacogn Rev.*, 2012; 6: 56–60.
27. Zarshenas MM, Moein M, Samani SM, Petranfa P. An overview on ajwain (*Trachyspermumammi*) pharmacological effects;modern and traditional. *J Nat Remedies,* 2013; 14: 98–105.
28. Ram A HN, SriwastavaN.K, MakhijaI.k, Shreedhara C.S. Anti-inflammatory activity of *AjmodadiChurna* extract against acute inflammation in rats. J-Aim., 2012 Jan-Mar; 3(1): 33–37.
29. Umar S, Asif M, Sajad M, Ansari MM, Hussain U, Ahmad W. Anti inflammatory and antioxidant activity of *Trachyspermumammi* seeds in collagen induced arthritis in rats. *Int J Drug Dev Res*, 2012; 4: 210–19.
30. Chaubey MK. Fumigant toxicity of essential oils from some common spices against pulse beetle *Callosobruchuschinensis* (*ColeopteraBruchidae*) *J Oleo Sci.*, 2008; 57: 171–9.
31. Velazhahan R, Vijayanandraj S, Vijayasamundeeswari A, Paranidharan V, Samiyappan R, Iwamoto T., etal. Detoxification of aflatoxins by seed extracts of the medicinal plant *Trachyspermumammi* (L.) Sprague ex Turrill-structural analysis and biological toxicity of degradation product of aflatoxin G1. Journal of Food Control, May, 2010; 719-725.
32. Hussein G, Miyashiro H, Nakamura N, Hattori M, Kakiuchi N, Shimotohno K. Inhibitory effects of sudanese medicinal plant extracts on hepatitis C virus (HCV) protease. *Phytother Res.*, 2000; 14: 510–6.
33. Kaur H. Estrogenic activity of some herbal galactogogue constituents. *Indian J AnimNutr.*, 1998; 15.
34. Tamura T, Iwamoto H. Thymol: A classical small-molecule compound that has a dual effect (potentiating and inhibitory) on myosin. *BiochemBiophys Res Commun*, 2004; 318: 786–91.
35. Paul S, Kang SC. *In vitro* determination of the contraceptive spermicidal activity of essential oil of *Trachyspermumammi* (L.)Sprague ex Turrill fruits. *New Biotechnology, 2011; 28:* 684-690.

36. Ramaswamy S, Sengottuvelu S, Sherief SH, Jaikumar S, Saravanan R., et al. Gastroprotective activity of ethanolic extract of *Trachyspermumammi* fruit. *Int J Pharm Bio Sci.*, 2010; 1: 1–5.
37. Boskabady MH, Alizadeh M, Jahanbin B. Bronchodilatory effect of *Carumcopticum* in airways of asthmatic patients. Therapie, 2007; 62: 23-29.
38. Kolarsick, Paul A.J, BS; Kolarsick, Maria Ann. Anatomy. Phyisiology of the skin.Journal of the Dermatology Nurses Association, 2011; 3(4): 203-213.
39. Tripathi SV, MD, Gustafson CJ, MD, HuangKE, MS., et al. Side effects of common acne treatments. Expert Opinion on drug Safety, 2013; 12: 39-51.
40. Johnkraft, Antalifreiman. Management of acne. Cmaj., 2011.
41. Dawson AL, Dellavalle RP. Acne vulgaris. TheBMJ., 2013; 346.
42. Talebi Z, Afshari GK, Nasrullahi SA, FiroozA. Potential of Trachyspermumammi (Ajwain) gel for treatment of facial acne vulgaris:A pilot study with skin biophysical profile assessment and red fluorescence photography. Research Journal of Pharmacognosy (RJP), 2020; 7(2): 61-69.
43. Sriram Bhatt M. SRB's Manual of Surgery, New Delhi: Jaypee Brothers Medical Publishers, Daryaganj New Delhi: 4th Edition01.
44. Williams NS. Bailey and Love Short Practice of Surgery. CRC Press Taylor and Francis group 27th edition., 2018; 24.
45. Chandank Sen. Human Wounds and Its Burden: An Updated Compendium of Estimates, Mary Ann Libert. Inc Publishers, 2019; 14 Feb.
46. Nicholas J Percival. Classification of wounds and their management. Surgery (Oxford), 2002; 114-117.
47. GilaniSR, Mahmood Z, HussainMushraf. Preliminary evaluation of antimicrobial activity of cream formulated with essential oil of Trachspermum Ammi. Pak. J. Pharm. Sci., 2013; 26(5): 893-896.
48. T. Zuberbier. Urticaria. European journal of allergy and clinical immunology, 2003; 1224-1234.
49. Shelley WB, Shelley ED. Adrenergic urticaria: a new form of stress-induced hives. The lancet, 1985; 1031-3.
50. Nadkarni K.M. Indian Plants and Drugs. Srishti Book Distributors: New Delhi, 89-90.
51. Hamid S.M, Farooqui A.H. Evaluation of Efficacy of Safoof-e Ajwain in the management of Shara (Urticaria): A Prospective open label Clinical Study. Int Journal of Advances in Pharmacy Medicine and Bioallied Sciences, 2016; 4: 15-21.

52. M. R. Namazi, "Neurogenic dysregulation, oxidative stress, autoimmunity, and melanocytorrhagy in vitiligo: can they be interconnected?" *Pigment Cell Research*, 2007; 20: 360–363.
53. Christina Bergqvista, Khaled Ezzedine. Vitiligo: A Review, Dermatology, 2020; 571–592.
54. Abuduaini A, Lu X,Zang D, Wu T, Aisa H Effects of Traditional Carawayformulation on Experimental models of Vitiligo and Mechanism of Melanogenesis. Evidence-Based Complementary and Alternative medicine, 2021.
55. AleksandrUrakov. What are bruises? Causes, Symptoms, Diagnosis, Treatment, Remedies, 2020; 5: 1-5.
56. Reddy KN, MurtyOP. The Essentials of Forensic Medicine & Toxicology. Jaypee Brothers Medical Publishers: Daryaganj New Delhi, 34th Edition.
57. Gani N. Khazainul Advia. Idara Tarjuman-e-TibLahore: Aijaz Publishing house Delhi, 2: 440-442.
58. Stevens J. Fungal skin infections, Unm School of medicine, 2013.
59. Sharma B, Nonzom S. Superficial mycoses, a matter of concern: Global and Indian scenario-an updated analysis, 2021.
60. Jain N, Sharma M. Joshi SC, kaushik U, Chemical Composition, Toxicity and Antidermatophytic activity of Essential oil of Trachyspermumammi. Indian J Pharm Sci., 2018; 135-142.
61. Wahab A, Ilyas Q, Farooq S, Javaid S, Ahmed S., etal. invitro and invivoanticandidal activity of Trachyspermumammiethanolic extract and thymolcomtaining hexanes fraction.Natural product research, 2021; 35
62. S. K. Pandey, ShikhaUpadhyay &A. K. Tripathi. Insecticidal and repellent activities of thymol from the essential oil of *Trachyspermumammi* (Linn) Sprague seeds against *Anopheles stephensi.Parasitology Research*, 2009; 105: 507–512.
63. B DeniNewencyclopedia of herbs and their uses, Dorling Kindersley, London, (2001).
64. GT Grossberg, B FoxThe essential herb-drug-vitamin interaction guide: the safe way to use medications and supplements together, Random House, New York, (2008).