

BADIYAN (*FOENICULUM VULGARE* MILL.): AN IMPORTANT DRUG OF UNANI SYSTEM OF MEDICINE

¹Md. Naquibuddin, ²*Hamiduddin and ³Zeba Reyaz

PG Scholar¹, Assistant Professor²

Dept. of Ilmu Saidla (Unani Pharmacy) National Institute of Unani Medicine (NIUM), Bangalore-560091.

³PG Scholar Dept. of Ilmu Advia (Pharmacology) National Institute of Unani Medicine (NIUM), Bangalore-560091.

*Corresponding Author: Dr. Hamiduddin

Assistant Prof., Dept. of Ilmu Saidla (Unani Pharmacy) National Institute of Unani Medicine (NIUM), Bangalore-560091.

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ABSTRACT

Feoniculum vulgare is a species of flowering plant in the Apiaceae / Umbelliferae family, widespread in the Mediterranean region. In Unani system of medicine it is either used as a single drug or as an ingredient in many Unani formulations which are use in the treatment of various ailments of the body. In the present manuscript the information available about this drug in Unani literature, phytochemical and pharmacological investigations. *Badiyan* is a Carminative, Concoctive of phlegm and black bile, Analgesic, Emmenagogue, Anti flatus, Spermatogenic, Galactopoeitics etc. It is used in the treatment of Amenorrhoea, galactopoeitics, Halitosis, Cataract, Diuretic, Flatul colic, Stomatitis and Jaundice diseases. Pharmacological and clinical investigation of *Feoniculum vulgare* revealed Hepatoprotective activity, Antifungal activity, antibacterial activity, Anti inflammatory activity, Anti-diabetic activity, Anxiolytic activity, Thrombolytic activity, Anti carcinogenic activity, Diuretic activity, Antihirsutism activity, Repellent activities

KEYWORDS: Badiyan, phytochemical, Unani formulation, Single drug, Ailments.

INTRODUCTION

Badiyan is the dried ripe fruits of *Feoniculum vulgare* Mill. of Umbelliferae family.^[1] It is a biennial medicinal and aromatic plant reaching up to height of up to 2.5 m with hollow stems. The leaves grow up to 40 cm long; they are finely cleft with the ultimate segments filament (thread like) of approximately 0.5 mm wide.^[2] It is described that these seeds are famous which are greenish or yellowish in colour and its taste is like sweetish.^[3] It is apparently thought to have originated from Southern Europe and from the Mediterranean region. It is produced in every part of the world as a spice, vegetable, or as a medicinal and essential oil plant. Fennel seeds are an established ingredient in many places and Africa is one of the leading producers.^[4] In India fennel seeds are indigenous to the States like Haryana, Punjab, Himachal Pradesh, Maharashtra, and Uttar- Pradesh.^[5]

MATERIAL AND METHODS

A bibliographic search was carried out to collect the available information on *Badiyan*. Contemporary reference books, relevant articles, periodicals, peer reviewed indexed journals, online search and other published works available on Pub Med, Science Direct, and Scopus were searched to retrieve online literature.

OBSERVATIONS

Historical Background: Fennel is one of the most prominent herbs from all around the world and its history dates back to the ancient times. Fennel has derived its name from Marathon (which means "place of fennel") - a battle site between the Persians and Athenians, usually the Athenians used to win the battle and waived the fennel stalks as an objective symbol of victory, still there is no evidence to proof that Fennel was cultivated there. Henceforth, any Pheidippides who ran to Athens from Marathon and brought the news of victory against the battle between Persians were rewarded with fennel.^[5] "Native to the Mediterranean region, fennel is presently cultivated in calm areas around the globe. The seeds are accumulated in autumn. Dioscorides, in the 1st century CE, expresses that "the juice, when put into the eye, helps vision, and into the ear, kills the worms (for example bacteria) that develop there."^[6]

Scientific/Taxonomical classification^[7]

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Sub Class: Rosidae
Order: Apiales
Family: Apiaceae/Umbelliferae

Genus: *Foeniculum* Mill.
Species: *Foeniculum vulgare* Mill.
Botanical Name: *Foeniculum vulgare* Mill.^[8]
Synonym: *Foeniculum foeniculum* (L.)

Vernacular Names

Arabic: Rajiyanaj,^[1,3,9-10] **Ayurvedic:** Mishreyaa, Mishi, Madhuraa,^[11] **Assamese:** Guvamuri,^[1] **Brazil:** Endro, Funcho,^[12] **Bengali:** Meetha zeera, Panmohuri,^[3,13] **China:** Hsiao hui hsiang, Hui xiang, Shih lo, Tzu mo lo,^[14] **English:** Fennel,^[1,15] **France:** Fenouille,^[12] **French:** Fenouil,^[12] **Gujarati:** Hariyal, Variyal,^[1,10] **Hindi:** Bari saunf, Saunf,^[13,15] **Indonesia:** Adas, Adas landi, Adas londa, Adas pedas, Adasa, Adase, Adeh manih, Adhas, Das padas, Denggu-denggu, Hades,^[14] **Jordan:** Shomar,^[12] **Japan:** Ui-kyo, Uwiicho,^[14] **Korea:** Sohoehyang,^[12] **Kannada:** Badi sopu, Dodda sopu,^[1] **Kashmiri:** Saunf, Badanai,^[1] **Marathi:** Badishep, Bari shophi,^[1,13] **Malayalam:** Kattusatakuppa, Parinjaeragum, Perum Jeerakam,^[1,15] **Mexico:** Beche gueza rote extilla, Gueza rote xtila, Hinojo,^[14] **Malaysia:** Jintan manis, Jira,^[14] **Norway:** Fenikkel,^[12] **Nepal:** Sonf,^[14] **Oriya:** Panamadhuri,^[1] **Persian:** Badiyan wa Rajiyana,^[1,3,9-10] **Portuguese:** Funcho,^[12] **Punjabi:** Saunf,^[1] **South Africa:** Vinkel, Wulde, anyswortel,^[14] **Siddha/Tamil:** Sombu, Shombu,^[1,13] **Sanskrit:** Misi, Mishreya, Madhurika,^[1] **Tibetan:** Zira dkarmo,^[14] **Tamil:** Perun siragum, Shombu, Sohikirai,^[1,15] **Telugu:** Sopu, Peddaajilakurra,^[1,13] **Urdu:** Saunf.^[1]

Habit and Habitat: Native to the Mediterranean region; now cultivated primarily in Punjab, Assam, Maharashtra and Vadodara (Gujarat).^[11] *Foeniculum vulgare*, Mill. is actually indigenous to the shores of the Mediterranean, extending eastwards, however is cultivated for medicinal use in the south of France, in Saxony and Wurtemberg in Russia and Galacia, and furthermore in India and Japan. Like other aromatic Umbelliferous fruits, fennel was outstanding to the people of olden ages, and was generally used in Europe during the medieval times. For medicinal use Saxon, Russia Galician or Roumanian fruits are to be liked, as it has been shown that they yield most volatile oil, and that the latter contains fenchone.^[16]

Botanical description: Drug comprises of dried mature but yet not completely fruit of *Foeniculum vulgare* Mill. Fam. Apiaceae. A stout glabrous, fragrant annual-perennial herb, 1.5-2.0 m high, generally cultivated throughout the temperate and sub-tropical areas of the world.^[17] **Flower and Fruit:** The inflorescence is genuinely large umbels right around 15 cm across on very irregular rays. The flowers are fairly tiny and generally androgynous. The petals are a rich yellow, broadly ovate and have an involute lobe at the tip. The style is short and nearly wart like. The fruit is glabrous, brownish or greenish-grey. They are 6 to 10 mm long, to some degree round and hollow with blunt ribs and firmly domed.^[18] **Leaves, Stem and Fruit:** The plant is biennial to perennial, around 80 to 150 cm high, glabrous, sea-green to glaucous and has a strong spicy smell. The stem

is erect, round, glabrous, smooth and loaded up with latex. The lower leaves are petiolate and have long sheaths.^[18] The fruits are oval-oblong, greenish brown to yellowish brown colour. They have an aromatic characteristic odour and the taste is sweet aromatics.^[19]

Microscopic: Transverse section of the fruit indicates pericarp with external epidermis of quadrangular to polygonal cells with a smooth cuticle and a few stomata; trichomes, absent; vittae, 4 dorsal and 2 commissural, with a length of each mericarp, intercostal, with an epithelium of brown cells and volatile cavity oil; mesocarp, with a lot of reticulate lignified parenchyma;; costae, 5 in every mericarp, each with 1 vascular strand having 1 inner xylem strand and 2 lateral phloem strands isolated by a heap of fibres; inner epidermis of very narrow, thin walled cells organized parallel to each other in groups of 5-7 a large number of these groups with longer 16 axis of their cells at an angle with those of adjoining groups (Parquetry arrangement); endosperm comprises of thick-walled, cellulosic parenchyma containing much fixed oil, microrosette crystals of calcium oxalate, and numerous aleurone grains upto 5 m in width; carpophore with extremely thick walled sclerenchyma in two strands, often unsplit with two strands near one another.^[1]

Description in Unani: It is a famous seed with fragrance^[20] which is greenish yellow in colour and sweet in taste.^[3] It is a herb having *Jangli* (Wild) and *Bustani* (Cultivated) variety, later is considered the bset. Plant of *Jangli* (Wild) *sounf* is green in color and it is smaller than *Bustani* (Cultivated). It is more than a meter in height, stem smooth and angular; branches thin, flowers in terminal umbels and are in yellow in color; seeds ovalate, greenish brown in color, aromatic, sweet, crowned, with five ridges on each side. If *Jungli* sounf chewed then tongue will anesthetised. *Jungli* seeds are bigger than *Bustani* seeds. In 1200 gm of sounf 36 ml of oil is extracted.^[10] Its leaves are like coriander leaves and as well as long as coriander leaves. Flowers of badiyan are small and of white in color. When wheat and gram is cultivated in the same time badiyan is cultivated.^[21]

Hissae mustamela (Part used): Seeds,^[3,10,20] Beekh-e-Badiyan.^[3]

Mizaj (Temperament): Jungli Badiyan *Har* (Hot) 3 *Yabis* (Dry) 3. Bagi Badiyan *Har* (Hot) 2 *Yabis* (Dry) 1.^[20] *Har* (Hot) 2 *Yabis* (Dry) 1^[9] *Har* (Hot) 2 *Yabis* (Dry) 2. According to *Buqrat Har* (Hot) 2 *Yabis* (Dry) 1. According to some physician *Har* (Hot) 3 in 1st degree and *Yabis* (Dry) 1 in the last degree.^[10]

Afa'al (Pharmacological action in Unani Medicine): *Kasir-i-Riyah* (Carminative), *Mundij-i-Balgham wa Sawda'* (Concoctive of phlegm and black bile), *Muwallid-i-Laban* (Galactopoietics),^[3] *Mufatteh Sudad* (Deobstruent),^[1,22] *Dafae dard* (Analgesic),^[9] *Mudirr-i-Laban* (Galactagogue), *Mudirr-i-Bawl* (Diurectic),

Mudirr-i-Hayd (Emmenagogue),^[20] *Muwallid-i-Mani* (Spermatogenic)^[10,22] *Mohallil-e-warm* (Antiinflammatory),^[15] *Muharrrik* (Stimulant),^[23] *Mujaffif* (Desiccant), *Muqavvie Basr*, *Mufatt-i-Hasah* (Lithotriptic), *Ghathayan* (Nausea), *Mulattif* (Demulcent), *Dafi'-i-Riyah* (Anti flatus), *Dafi'-i-Muhallil* (Anti resolvent), *Qabid* (Astringent).^[22]

Istemaal (Uses): *Taqtir al-Bawl* (Dribbling of urine), *Ihtibas al-Bawl* (Amenorrhoea), *Sudad al-Kabid* (Intrahepatic obstruction),^[10] *Ihtibas al-Bawl* (Retention of urine), *Muwallid-i-Laban* (galactopoietics),^[3,22] *Sudad al-Tihal* (Obstruction within spleen),^[3] *Waja' al-Mi'da* (Gastralgia), *Du'f al-Mi'da* (Weakness of stomach), *Zof-e-Basarat* (Weakness of vision)^[11] *Wajaul Mafasil* (Rheumatoid arthritis),^[15] *Bakhr al-Fam* (Halitosis).^[23] *Nuzul al-Ma* (Cataract), Antidote for Animal toxin, *Yarqan* (Jaundice), *Salas al-Bawl* (Urinary incontinence), *Mudirr-i-Bawl* (Diuretic), *Dam'a* (Epiphora), *Khafaqan* (Palpitation), *Ghashi* (Syncope), *Riyah Qulanj* (Flatus colic), *Idrar-i-Bawl* (Diuresis), *Nafkh al-Mi'da* (Flatulence), *Yaraqan* (Jaundice), *Mufattit-i-Hasah* (Lithotropic), *Salas al-Bawl* (Urinary incontinence), *Tanqiya Rahim* (Elimination of morbid material from uterus), *Humma Na'iba* (Intermittent fever), *Ilthab al-Mi'da* (Stomatitis).^[22]

Miqdare khoodrak (Dose): 4 to 9 gm,^[10] 5 to 7 gm,^{1,3,20} 4.5 gm to 7 or 9 gm,^[22]

Muzir (Adverse effect): It causes headache in hot temperament person,^[10] Pain in muscles, headache and cause dipsetic.^[9,24]

Musleh (Corrective): Kishneez (*Coriandrum sativum* Linn.), Sandal Safaid (*Santalum album* Linn.),⁽³⁾ Sikanjabeen (Liquid preparation with honey and vinegar),^[9,22] Kafoor (*Cinna-momum camphora* Nees & Eberm.)^[22]

Badal (Substitute): Tukhme karafs (*Apium graveolens* Linn.), Anisoon (*Pimpinella anisum* Linn.),^[3,9,10]

Shelf life: 6 years and of *Beekhe Badiyan* is 1 year^[21]

Murakkabat (Compound formulation): Habb-e-Ghariqoon, Qurs-e-Mulaiyin, Jawarish-e-Narmuskh, Jawarish Zarooni Sada, Majoon-e-Muqil, Majoon-e-Musaffi-e-Khoon, Majoon-e-Nankhwah, Raughan-e-Baladur, Araq-e-Badiyan, Araq-e-Juzam, Sikanjabeen Buzoori Motadil, Sharbat-e-Sadar, Sufoof-e-Hazim Kalan, Sufoof-e-Tabkheer,^[11] Joshanda Khabshul Hadeed, Jawarish Sosan, Majoon-e-Rewand,^[25] Jawarish Ood Mulayyin, Jawarish Fodanji, Jawarish Zarooni, Habbe Jaosheer, Habbe Mushtahi.^[26]

Ethanobotanical and other Literature: Part used is leaves and seeds and it is used as antidiabetics.^[16] Function of *Foeniculum vulgare* are Carminative, stomachic, antispasmodic, emmenagogue, galactagogue,

anti-inflammatory, diuretic. Relieves bloating, nausea, settles stomach and stimulates appetite. Additionally used in amenorrhoea and enuresis.^[11] Felling of cold and pains in stomach and lower abdomen, dysmenorrhoea, hernia pain. Fennel is used to confer flavour and fragrance to soups, meat dishes, sauces, bakery and candy store, culinary preparations, tobacco, cordialis and alcohols.^[27] Indication of fennel oil approved by commission E in Cough, Bronchitis and Dyspeptic complaints.^[18] *Fennel water* (Aqua Foeniculi) prescribed in colic and flatulence in children; oil (from seeds) is anodyne, diuretic, stimulant and vermicide; checks the griping pain due to excessive use of purgative; leaves: diuretic and increase the secretion of perspiration; root: diuretic and purgative.; *Fruits:* anthelmintic, aromatic, carminative, emmenagogue, stimulant and stomachic.^[28]

Chemical constituents: Fennel seed contain about 8% volatile oil (about 50-60% anethole, among others 10-15% fenchone and methylchavicol), flavonoids, coumarins (including bergapten) and sterols.^[11]

Essential oil / Volatile oil: Seeds yielded α -phellandrene (0.44), methylchavicol (3.50), fenchone (10.20), α -pinene (3.0), limonene (4.56), camphene (0.65),^[29] limonene (4.25-9.15), γ -terpinene (0.86-1.57), linalool, trans-anethole (75.68-86.52), estragole (3.25-5.21),^[30] dipentene, β -pinene, myrcene, p-cymene,^[31] thujene, ocimene,^[32] α -fenchene, sabinene, α - and β -terpinene, trans-ocimene.^[28]

Coumarin: From fennel fruit bergapten, imperatorin, marmesin, psoralen, seselin,^[31] and from root umbelliferone.^[28]

Fixed oil: From seed petroselinic acid (C18:1)^[31]

Cinnamic acid derivatives: Hydroxycinnamic acids, cynarin.^[28]

Other Acids: esters of arachidic acid, hydroxybenzoic, 7-octadecenoic acids, Ascorbic acid.^[28]

Sterols: β -sitosterol,^[31]

Saponin: stigmasterol^[31]

Flavonoids glycosides: 3- glucuronides of kaempferol, quercetin-3-glucoglucuronide,^[28] Quercetin,^[31]

Quercetin: anethole, fenchone, α -piene, dipentene, anisaldehyde, fenculin isolated; identification of fenchone and anethole in oil by GLC;^[31]

Vitamin: From root Vitamin C (Ascorbic acid), Vitamin B3 (Niacin), Vitamin B2 (Riboflavin),^[28]

REPORTED PHARMACOLOGICAL ACTIONS

Hepatoprotective Activity: Özbek et al displayed Hepatoprotective activity of *Foeniculum vulgare* (fennel)

essential oil (FEO) using carbon tetrachloride (CCl₄) model in rats. The work indicate a potent hepatoprotective action.^[33]

Antifungal activity: Singh G *et al* studied antifungal and antioxidative potential of *Foeniculum vulgare* volatile oil and its acetone extract. Volatile oil by inverted petriplate method, showed complete zone inhibition against *Fusarium graminearum*, *Aspergillus flavus* and *Fusarium moniliforme* at 6 µL dose and *A. niger* at 4 µL dose. By food poison technique, the volatile oil and extract both showed good to moderate zone of inhibition. Volatile oil and extract both showed strong antioxidant activity in comparison with butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) by measuring peroxide and thiobarbituric acid values.^[34]

Antibacterial activity: Khan NT studied *in vitro* antibacterial activity of *Foeniculum vulgare* Seed Extract. This study was conducted against a variety of pathogenic bacteria, to determine the antibacterial activity of *Foeniculum vulgare* seed extract.^[35]

Anti-inflammatory activity: Choi EM *et al* displayed antiinflammatory, analgesic and antioxidant activities of the fruit of *Foeniculum vulgare*. Result showed significant increased the activities of plasma catalase and superoxide dismutase (SOD), and the amount of high density lipoprotein-cholesterol and the malondialdehyde (MDA) (as a measure of lipid peroxidation) level was decreased markedly in *F. vulgare* fruit methanolic extract group compared to the (Pb0.05) control group. Results apparently support the use of *F. vulgare* fruit methanolic extract in inflammation relief.^[36]

Anti-diabetic activity: Soud et al. investigated the *Foeniculum vulgare* Mill essential oil, in addition to its histopathological analysis in streptozotocin, induced diabetic rats for its hypoglycaemic effect and antioxidant function. Essential oil corrected the hyperglycemia and pathological defects in diabetic induced rats, which could be partly due to its antioxidant effect and redox homeostasis restoration. This makes its inclusion in the antidiabetic drug industry possible.^[37]

Anxiolytic activity: Mesfin M *et al* studied evaluation of anxiolytic activity of the essential oil of the aerial part of *Foeniculum vulgare* Miller in mice. Essential oil of the aerial parts of *F. vulgare* possess anxiolytic activity in lower doses, while the oil is potentially sedative at a higher dose. The work indicate that essential oil may have potential therapeutic applications for anxiety management.^[38]

Thrombolytic activity: Tognolini M *et al* showed protective effect of *Foeniculum vulgare* essential oil and anethole in an experimental model of thrombosis. The results demonstrate for *Foeniculum vulgare* essential oil, and its main component anethole, a safe antithrombotic

activity that seems due to their broad spectrum antiplatelet activity, clot destabilizing effect and vasorelaxant action.^[39]

Anti carcinogenic activity: Zaahkouk SA *et al* displayed anti carcinogenic activity of Methanolic Extract of Fennel Seeds (*Foeniculum vulgare*) against breast, colon, and liver cancer cells. Results of the SRB assay showed that all the extracts with IC₅₀ 24.5±.08 inhibited MCF7 cells while HEPG-2 IC₅₀ is 28.7±.04 and HCT 116 IC₅₀ is 59.8±.09µG / ml. The electrophoresis of SDS polyacrylamide gel showed a clear distinction between different classes of treated and nontreated cancer cells. DNA extracted from the treated cells showed DNA heterogeneity between treated and untreated (control) cancer cells suggesting apoptosis. Analysis of RT-PCR showed raise in expression of genes P53 and Bax genes.^[40]

Diuretic activity: Jemal A studied Evaluation of the diuretic activity of aqueous and 80% methanol extracts of *Foeniculum vulgare* Mill (Apiaceae) leaf in rats. The work indicate that the plant has considerable activity, the aqueous being better than 80 percent methanol extract, confirming the conventional claim. The main constituents such as flavonoids, tannins, terpenoids, and alkaloids present in the plant may have contributed to the diuretic activity being observed.^[41]

Antihirsutism activity: Javidnia K *et al* displayed antihirsutism activity of fennel (fruits of *Foeniculum vulgare*) extract—a double-blind placebo controlled study. In the study shows treatment effectiveness with the cream containing 2% Fennel is higher than the cream containing 1% Fennel and these two were more effective than placebo. The mean values of hair diameter reduction was 7.8%, 0.5% and 18.3% for patients receiving the creams containing 1%, 0% and 2% (placebo) respectively.^[42]

Repellent Activity: Kim DH *et al* studied repellent activity of constituents identified in *Foeniculum vulgare* fruit against *Aedes aegypti* (Diptera: Culicidae). At a dosage of 0.4 mg / cm², (+) -fenchone and (Z)-9-octadecenoic acid, in a skin test with female mosquitoes, moderate repellent activity was shown at 30 min after treatment, while deet received > 1 h of protection against adult mosquitoes at 0.2 mg / cm². (Z)-9-Octadecenoic acid was a repellent agent more active than (E)-9-Octadecenoic acid. (+) -Fenchone and (E)-9-octadecenoic acid merit further analysis as possible repellent to mosquitoes or as lead compounds.^[43]

DISCUSSION

Badiyan (*Foeniculum vulgare* Mill) has been in use since time immemorial to treat wide range of indication. The plant contains Essential oil / Volatile oil, Coumarin, Fixed oil, Cinnamic acid derivatives, Sterols, Saponin, Flavonoids glycosides, Quercetin and Vitamin. Complete review suggests that, based upon the capable

pharmacological activity of the drug its indication has been detailed in the classical texts of USM. Several other pharmacological actions mentioned in Unani text have been validated. Reported Pharmacological activity on *Badiyan* are Hepatoprotective activity, Antifungal activity, antibacterial activity, Anti inflammatory activity, Anti-diabetic activity, Anxiolytic activity, Thrombolytic activity, Anti carcinogenic activity, Diuretic activity, Antihirsutism activity, Repellent activity studies. Findings also suggest several new pharmacological activities. Such validations of the classical argument and reported pharmacological activity indicate that *Badiyan* is a highly potent pharmacologically active herb and future research work should be guided towards clinically evaluating such properties using a standardized scientific method.

CONCLUSION

The scientific studies have proved most of the claims of traditional medicines. Though, further, detailed clinical research appears worthwhile to search the full therapeutic potential of this plant in order to establish it as a standard drug.



Figure 1: Badiyan (*Foeniculum vulgare*).

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