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Exploring the Therapeutic Potential and Historical Significance of Fennel

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Abstract: *Fonticulusvulgare Mill commonly called fennel has been used in traditional medicine for a wide range of ailments related to digestive, endocrine, reproductive, and respiratory systems. Additionally, it is also used as a galactagogue agent for lactating mothers. The review aims to gather the fragmented information available in the literature regarding morphology, ethnomedicinal applications, phytochemistry, pharmacology, and toxicology of Foeniculum vulgare. It has been used for more than forty types of disorders. Phytochemical studies have shown the presence of numerous valuable compounds, such as volatile compounds, flavonoids, phenolic compounds, fatty acids, and amino acids. Compiled data indicate their efficacy in several in vitro and in vivo pharmacological properties such as antimicrobial, antiviral, anti-inflammatory, antimutagenic, antinociceptive, antipyretic, antispasmodic, antithrombotic, apoptotic, cardiovascular, chemomodulatory, antitumor, hepatoprotective, hypoglycemic, hypolipidemic, and memory enhancing property. Foeniculum vulgare has emerged as a good source of traditional medicine and it provides a noteworthy basis in pharmaceutical biology for the development/formulation of new drugs and future clinical uses.Foeniculum vulgare (Apiaceae) commonly known as fennel is a well known and important medicinal and aromatic plant widely used as carminative, digestive, lactogogue and diuretic and in treating respiratory and gastrointestinal disorders. Its seeds are used as flavourings in baked goods, meat and fish dishes, ice cream, alcoholic beverages and herb mixtures. Phenols, phenolic glycosides and volatile aroma compounds such as trans-anethole, estragole and fenchone have been reported as the major phytoconstituents of this species. Different pharmacological experiments in a number of in vitro and in vivo models have convincingly demonstrated the ability of F. vulgare to exhibit antifungal, antibacterial, antioxidant, antithrombotic and hepatoprotective activities, lending support to the rationale behind several of its therapeutic uses. Phenolic compounds isolated from F. vulgare are considered to be responsible for its antioxidant activity while the volatile aroma compounds make it an excellent flavouring agent. The present review is an up-to-date and comprehensive analysis of the chemistry, pharmacology, traditional uses and safety of F. vulgare.*

Keywords: Foeniculum vulgare, Phenols, Phenolic, glycosides, Pharmacology, Antibacterial activity, Antioxidant activity

I. INTRODUCTION

Foeniculum vulgare Mill. Is a biennial medicinal and aromatic plant belonging to the family Apiaceae (Umbelliferaceae). It is a hardy, perennial–umbelliferous herb with yellow flowers and feathery leaves. It grows to a height of up to 2.5 m with hollow stems. The leaves grow up to 40 cm long; they are finely dissected with the ultimate segments filiform (thread like) of about 0.5 mm wide. The flowers are produced in terminal compound umbels. The fruit is a dry seed 4–10 mm long. It is generally considered indigenous to the shores of Mediterranean Sea but has become widely naturalised in many parts of the world especially on dry soils near the sea coast and on the river banks. Some authors distinguish two sub-species of fennel, piperitum and vulgare: sub-species piperitum has bitter seeds, while sub-species vulgare has sweet seeds which are used as flavouring agents in baked goods, meat and fish dishes, ice creams, alcoholic beverages, etc due to their characteristic anise odour (Diaaz-Maroto et al., 2006). Morphological differences between these two sub-species are not always clearly defined.

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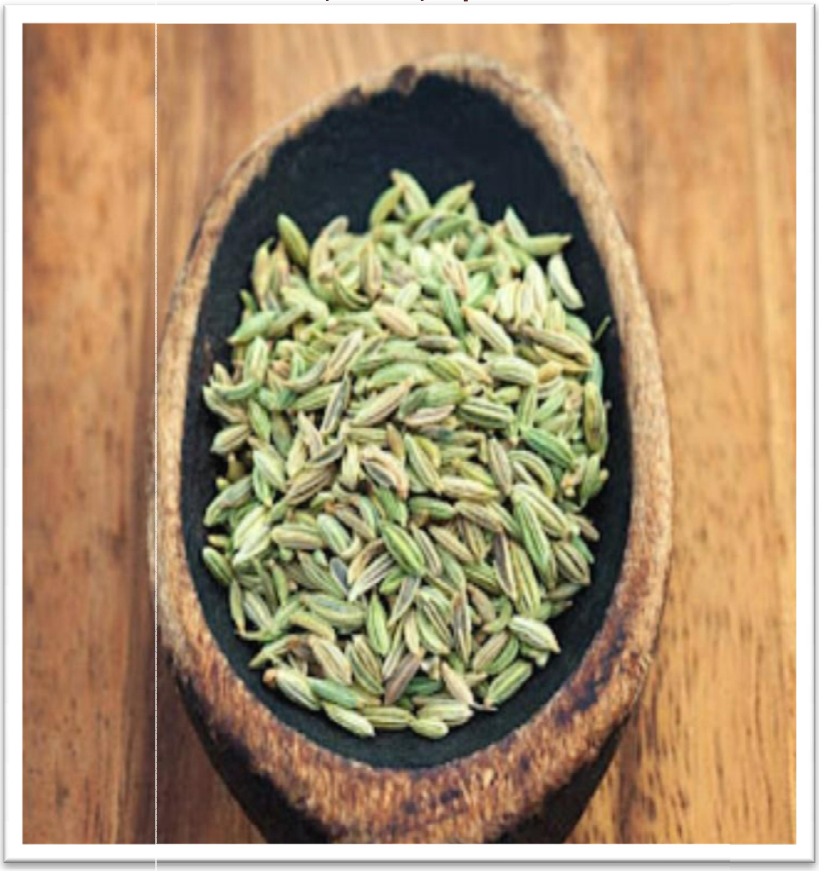

Pharmacology –Fennel has been used as a flavoring agent, a scent, and an insect repellent, as well as an herbal remedy for poisoning and GI conditions. It has also been used as a stimulant to promote lactation and menstruation as well as to improve symptoms in postmenopausal women. However, clinical evidence to support the use of fennel for any indication is limited.

Dosing

Fennel seed and fennel seed oil have been used as stimulant and carminative agents in doses of 5 to 7 g and 0.1 to 0.6 mL, respectively. Oral essential fennel oil (30%) capsules and fennel extract vaginal cream (5%) have been used to improve symptoms in postmenopausal women at 200 mg/day and 5 g/day, respectively. Fennel is available in many different types of Products, including essential oils, seed extracts, seed powders, teas, and creams. There isn't enough reliable information to know what an appropriate dose of fennel might be. Keep in mind that natural products are not always necessarily safe and dosages can be important. Be sure to follow relevant directions on product labels and consult a

Pregnancy/Lactation

There are documented adverse reactions and emmenagogue effects. Avoid use Fennel is possibly unsafe to use when pregnant. Regularly using fennel has been linked to preterm birth.

Interactions-

One in vitro study suggested that the fennel constituent 5-methoxypsoralen has the ability to inhibit cytochrome P450 3A4. Therefore, fennel should be used cautiously with medications requiring this isoenzyme as a substrate.

Moderate Interaction

Be cautious with this combination

Birth control pills (Contraceptive drugs) interacts with FENNEL

Some birth control pills contain estrogen. Large amounts of fennel might affect estrogen levels in the body. Taking fennel along with birth control pills might decrease the effects of birth control pills. If you take birth control pills along with fennel, use an additional form of birth control such as a condom.

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Ciprofloxacin (Cipro) interacts with FENNEL

Ciprofloxacin is an antibiotic. Fennel might decrease how much ciprofloxacin the body absorbs. Taking fennel along with ciprofloxacin might decrease the effects of ciprofloxacin. To avoid this interaction, take fennel at least one hour after ciprofloxacin.

Estrogen interacts with fennel

Large amounts of fennel might have some of the same effects as estrogen. Taking fennel along with estrogen might decrease the effects of estrogen.

Tamoxifen (Nolvadex) interacts with FENNEL

Large amounts of fennel seem to affect estrogen levels in the body. Taking fennel along with tamoxifen might decrease the effects of tamoxifen.

Medications that slow blood clotting (Anticoagulant/ Antiplatelet drugs) interacts with FENNEL

Fennel might slow blood clotting. Taking fennel along with medications that also slow blood clotting might increase the risk of bruising and bleeding.

Adverse Reactions

Fennel may cause photodermatitis, contact dermatitis, and cross reactions. The oil may induce reactions, such as hallucinations and seizures. Four case reports of premature thelarche (breast development) in girls have been reported with the use of fennel. Poison hemlock may be mistaken for fennel.

Toxicology

Fennel oil is genotoxic in the Bacillus subtilis DNA repair test. Estragole, present in the volatile oil, has caused tumors in animals.

Pharmacognosy

Synonyms

Fructus foeniculli, Fennel fruit, Fenkel, Florence fennel, Sweet fennel, Wild fennel, Large fennel.

Biological Source

Fennel consists of the dried ripe fruits of Foeniculum vulgare Miller., belonging to family Umbelliferae**.**

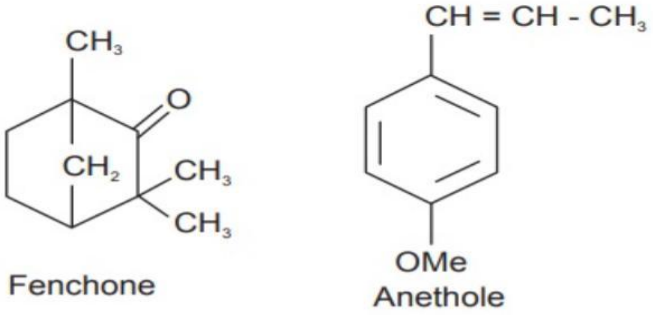
Geographical Source

Fennel is indigenous to Mediterranean countries and Asia; it is largely cultivated in France, Saxony, Japan, Galicia, Russia, India, and Persia.

Chemical Constituents

The best varieties of Fennel contain 4 to 5% of volatile oil. The primary constituents of volatile oil are 50 to 60% of anethole, a phenolic ester; and 18 to 22% of fenchone, a ketone. Fenchone is chemically a bicyclic monoterpene which is a colourless liquid and the odour and taste is pungent and camphoraceous. The oil of Fennel has β-pinene, anisic acid, phellandrine, and anisic aldehyde. Fennel also contains about 20% fixed oil and 20% proteins.

Medicinal Uses-



Fennel is used as stomachic, aromatic, diuretic, carminative, diaphoretic, as a digestive, Anti-cancer,pectoral, and flavouring agent. Anethole may have estrogen-like activity and inhibit spasms in smooth muscles. Fennel can increase

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production of bile, used in the treatment of infant colic, to promote menstruation in women, can increase lactation, act as antipyretic, antimicrobial and antiinflammatory. The leaves or seed, boiled in Barley-water, and drunk, are excellent for the nursing mother. Fennel is used to break flatulence, rouse urine, and eases the pain caused by stone and helps break it. The leaves, or fairly the seeds, boiled in water, helps to get rid of hiccups, cough and soothes the stomach of sick and feverish persons. The seed boiled in wine is good for those who have taken in poisonous herbs or mushrooms. The seed, or roots, assist to unwrap stumbling block of the liver, spleen and gall, and from pain and swelling and helps the yellow jaundice, the gout and cramps. Latest studies have found fennel to possess diuretic, choleric, and pain-reducing, fever- reducing, and anti-microbial in nature. The fennel tea conventionally made was a good eyewash. It is an accepted medicine for gas, acid stomach, gout, cramps, colic and spasms. Fennel oil was conventionally rubbed over painful joints to reduce pain. It was gargled for roughness and painful throat. Fennel water has characteristics comparable to those of anise and dill water. When assorted with sodium bicarbonate and syrup, these waters make up the domestic 'Gripe Water, used to reduce the flatulence of infants. The leaves, seeds and roots are greatly used in drink or broth to slim down persons who are too fat. The distilled water of the complete herb dropped into the eye to clean them from the mists and films that blocks vision. Fennel not only helps in proper digestion, but also has the capacity to reduce bad breath and body odor that originates in the intestines. Fennel also acts as an excellent digestive aid to ease abdominal cramps, gas and bloating. Fennel is one of the plants that keep away fleas, and the anise like taste may be a more acceptable choice for upset stomach and gas in fussy dogs and In the mid 15th Century, it was said of fennel…"The juice of fenell put into a mans eares, killeth the wormes therein."

Adulterants

Fennel is generally adulterated with exhausted fennel and due to improper caring during harvesting they are also adulterated with sand, dirt, stem, weed seeds, etc in which part of volatile oil is removed either by extraction with alcohol or steam distillation. Fruits exhausted by water or steam are darker in colour, contain less essential oil and sink in water, but those exhausted by alcohol still hold 1 to 2% of oil in them.

Marketed Products

It is one of the ingredients of the preparations known as Abana, Shahicool, Anxocare (Himalaya Drug Company), Aptikid (Lubin Herbal Laboratory), Jalifaladi bati (Baidyanath), and Hajmola, Janum Gunti (Dabur).

Cultivation and Collection

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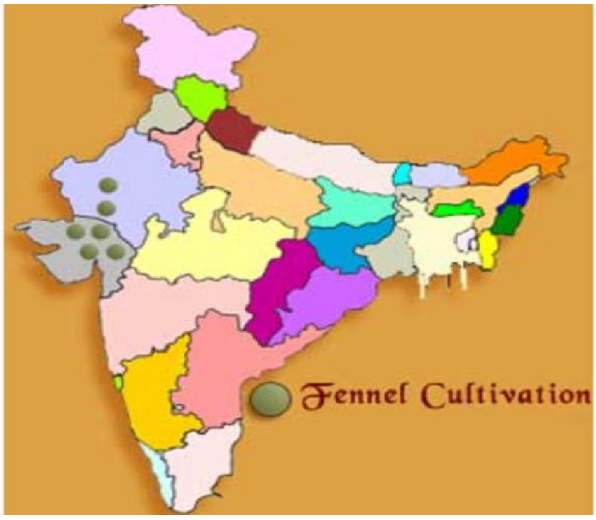
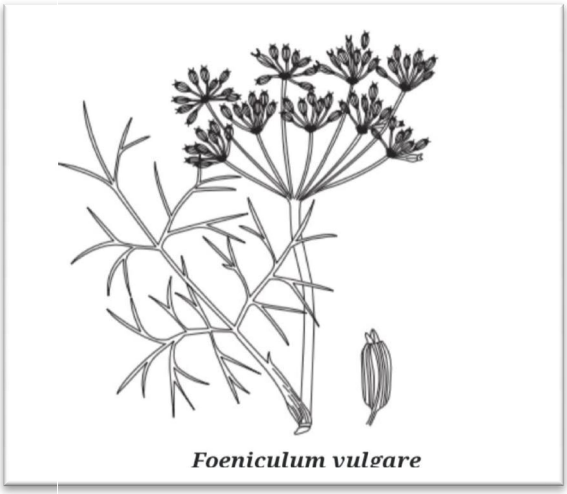
Fennel, a hardy, beautiful plant, perennial, umbelliferous herb, with yellow flowers and feathery leaves, grows wild in many parts of the world. Fennel is propagated by seeds during April in ordinary soil. Fennel requires abundance sun light and is adapted to dry in sunny situations, it does not call for heavily manured ground but it will yield more on well-drained calcareous soil. About 4 ½ to 5 lb of seed are sown per acre, either in drills or 15 inches apart, evenly covered with soil. The plants grow to a height of 2 m, erect and cylindrical and take enough space in branching. Most of the branches bearing leaves cut into the very finest of segments. The plant bears fruits in the second year and the bright golden flowers, flat terminal umbels bloom in July and August. The fruits are collected by cutting the stems in September, when the fruits are ripe. The stems are dried on sheaves under sun and later beaten to separate the fruits.

Characteristics-The fruit is an entire cremocarps with pedicels, oval-oblong and 5 to 10 mm long, 2 to 4 mm broad. It has greenish-brown to yellowish brown colour with five prominent primary ridges and a bifid stylopod at the apex.



Microscopy



The transverse section of mericarp region of fennel shows two prominent surfaces, the dorsal and the commissural surface. The commisural surface has a carpophore and two vittae, and the dorsal surface has a total of five ridges. The mericarp is divided into pericarp, consisting of the epicarp and mesocarp; the testa and the endocarp. Epicarp consists of polygonal cells of epidermis which are tangentially elon-gated and covered by the cuticle. Mesocarp has parenchyma cells with five bicollateral vascular bundles; below each primary ridge a lignified reticulate parenchyma surrounds the vascular bundles. There are four vittae on dorsal surface and two vittae on commisural or the ventral surface. Inner Epidermis or Endocarp shows parquetry arrangement (a group of four to five cells arranged parallelly at acute angles

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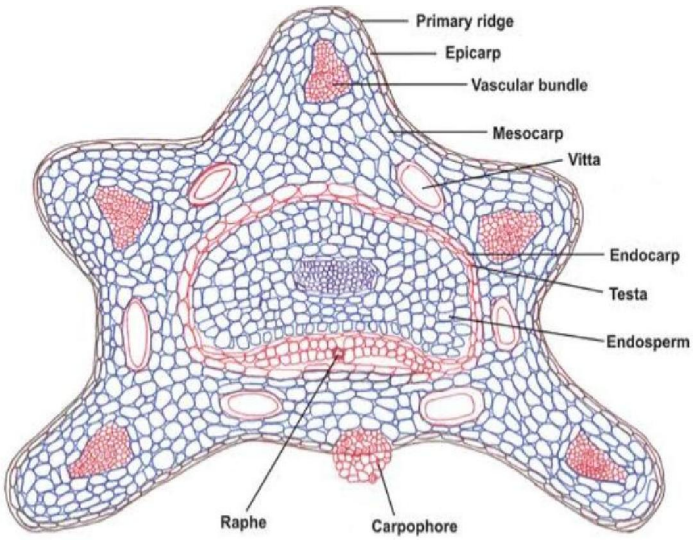
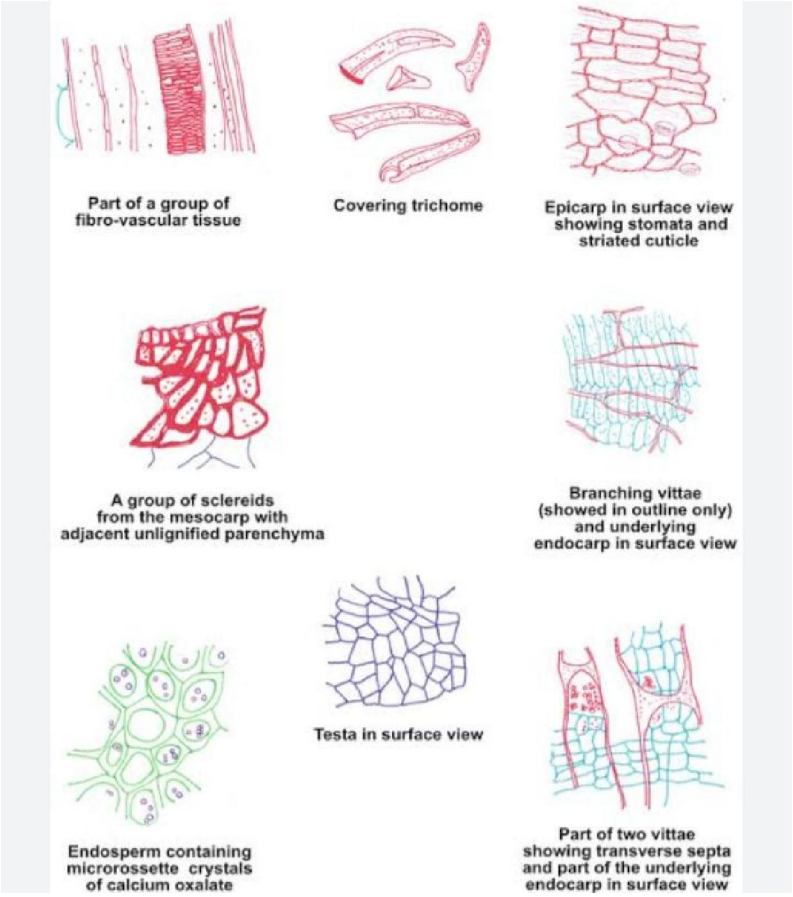
with groups of similar cells in different direction). Testa is a single-layered tangentially elongated cell with yellowish colour. Endosperm consists of thick-walled, wide polyhedral, colourless cells. Cells contain fixed oil, aleurone grains, and rosette crystals of calcium oxalate.



T. S. of Fennel fruit

Powder Characteristics -



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History

One physician from the thirteenth century noted in the Book of Physicians of Myddvai "he who sees fennel and gathers it not, is not a man but a devil." A contrary opinion led to the traditional saying that "sowing fennel is sowing sorrow" that predicted disaster to anyone giving away fennel.Fennel is an ancient seasonal herb. The fennel plant originated in the southern Mediterranean region and through naturalization and cultivation it grows wild throughout the Northern, Eastern, and Western hemispheres, specifically in Asia, North America, and Europe. It is cultivated in fields and also grows wild

Snake's Sight

When athletes run a marathon (26.2 miles), they re-enact the exploit by the Greek soldier Pheidippides who ran from Marathon to Athens in 490 BCE to announce the victory of the lightly armed Athenian troops on the heavy infantry of the Persian king Darius I, who was trying to invade and conquer Greece. Marathon runners probably do not know that the battle took place in a region where fennel (marathon in ancient Greek) grew abundantly, giving its name to the area as the fennel field (Illustration 1). "An Ancient Hippocrates (yes, he's the fellow the physician's oath is named for) suggested fennel could aid wet nurses to increase their milk supply". The origin of the ancient Greek name of fennel means a plant growing high. It probably refers to individuals of a much taller size than our cultivated ones, with also larger stalks (up to 3 inches). These stalks are full of a pith that inflames easily and smolders slowly, without burning the stalks themselves. Once emptied in that way, the hollow stalks were used in Antiquity in the way of a quiver. As a mythological tale goes, it is in a stalk of fennel prepared in that way that Prometheus hid the fire that he stole from Zeus to give it to humans and allow them to start modern life.Several centuries later, in the 1st century AD, we find fennel in the largest encyclopedia on materia medica compiled in Antiquity, De materia medica by the Greek Dioscorides. Contrary to his usual way, Dioscorides did not describe fennel in the chapter he devoted to it, indirectly indicating through this omission that the plant was well known. In the manuscript copies of the work that have survived, fennel is nevertheless represented in an Illustration that exactly captures its typical botanical structures and allowed for learning and identification in the past (Illustration 3).

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