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FENNEL (*Foeniculum vulgare*) 'Common Spice (*Foeniculum vulgare*) with Uncommon Properties'

Abhimanyu Dhanraj*

Department of Agriculture, Indian Institute of Forest Management, Bhopal, India

***Corresponding author:** Abhimanyu Dhanraj, Department of Agriculture, Indian Institute of Forest Management, Bhopal, India. E-mail: rajvirat353@gmail.com

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Abstract

Fennel (*Foeniculum vulgare* mill), an aromatic plant of Apiaceae (Umbelliferae) family. It is one of the oldest spice plants due to its important and significance in pharmaceutical industry applications. Its fruit which is commonly referred to as seeds, which are ridged, aromatic and oblong of ellipsoid Shaped. It is originally indigneous, belonging to Mediterrean region and has now been cultivated throughout the world and universally known as fennel in more than 100 other names. Its mature fruit and essential oils are widely used as flavoring agent in food products like liqueurs, bread, cheese and also as constituent ingredients in cosmetics and pharmaceutical products. In Mediterrean areas fennel is used as anti-inflammatory, analgesic, diuretic, antispasmodic, eye lotion and anti-oxidant remedy and integrator. Scientific reports related to morphological characteristics, phytochemical compounds and re-evaluation of the therapeutic importance of this medicinal plant which have been published.

Other names of fennel in different language: Spanish: Hinojo, French: Fenonil, German: Fenchel, Swedish: Fankal, Arabic: Shamar, Dutch: Venkel, Italian: Finocchio, Portuguese: Funcho, Russian: Fyenkhel, Chinese: Hui-Hsiang, Japanese: Uikyo

Fennel powder is used as a cataplasm for poisonous snake bites. In some investigation fennel was also found to speed up the elimination of poisons. Its fruits are also rich in anti-oxidants, anti-inflammatory, diuretics, gastro protective, secretomotor, secertolytic and antithrombotic activities. Fennel's bioactive molecules plays a significant role in human health and it can be used for various drug production.

Keywords: *Foeniculum vulgare* mill; Pharmacology; Traditional medicine; Therapeutic uses; Estragole

Introduction

Medicinal herbs used to treat diseases are common since ancient times. Nowadays, they are treated to be as an alternative of synthetic(chemical) drugs. This is due the less side effects compared to chemical drugs. These herbal medicines are bene icial and cost-effective for treating diseases [1,2].

From 42,20,00 lowering plants around the world more than 5000 ones are used for medicinal proposes. These medicinal herbs have fewer side effects than synthetic drugs and due to their antioxidant properties, it also reduces the higher risks of toxicity [3,4].

Foeniculum vulgare (fennel) is an aromatic plant belonging to Apiaceae (umbelliferae) family. It has two important sub-species and varieties, *F. vulgare* subsp. Vulgare var. vulgare referred to as bitter fennel. And *F. vulgare* subsp. Vulgare var. Dulce called as sweet fennel. These two varieties are commonly grown and commercially available for medicinal purposes.

Materials and Methods

It is commonly grown in arid and semi-arid zones. This herb plant has anti-inflamatory, antispasmodic, anti-septic carminative, analgesic and diuretics and also used for gastrointestinal disorder [5,6]. Small children's suffering from flatulence in colic and diphoretic can be cured by fennel fruit water [7,8]. In females, a hot water infusion is used to treat amenorrhea and also helps in improving lactation in lactating womens [9,10]. Its water is also helpful in improving eyesight and to open liver and clear spleen obstruction [11]. In some clinical disorders due to its anti-ulcer and anti-oxidant properties [12]. Some of Mexican traditional medicine studies shows that a decoction of fennel is generally used to treat tuberculosis and other respiration related diseases in East Africa the roots of fennel are roasted or boiled to treat gonorrhea [13,14]. Many essential oils of fennel are used in flavoring of liqueurs, bread, cheese and as essential ingredient of cosmetics and pharmacological constituents (Table 1) [15,16].

Table 1: Nutritional values of fennel per 100 grams.

Energy	345 kcal
Carbohydrate	52.29 g
Protein	15.80 g
Total fat	14.87 g
Dietary fiber	39.8 g

Results and Discussion

Phytology

Fennel is an English name of *Foeniculum vulgare* mill. Which belongs to Apiaceae family. It grows in many parts of the Mediterranean, the Europe and Asia. It is of height 1 m to 2 m with a very good aromatic and herbaceous values. Botanical description of *Foeniculum vulgare* is just like other plants but it gets difference in seeds. Its seeds are small having a length of near about 8 mm and width of 3 mm. some seed varieties are of sweet in taste with having some aromatic values. Seeds look long and narrow having cylindrical layout. Whose dimension varies according to plant's growth. Seeds looks like green in color and grooves having light-green texture. It is a perennial herb with stems grooved, leaves are intermittent, which is combined with fluffy, dark green and a blade divided into thin small pieces, there is sheath cover over the petiole, there flowers are bisexual with irregular or regular with yellow umbrella in the form of oval leads.

Phytochemistry

Fennel is a source of many chemicals like alkaloids, carbohydrates 48%, tannins, phenols, 6.3% water, 18.5% fibers, 10% fat, 9.5% proteins, 13.4% minerals, flavonoids as nonvolatile substances, the extract containing methanol has higher amounts of flavonoids [17]. Leaves of fennel plants have abundant minerals such as potassium, iron, sodium, niacin, thiamine, riboflavin, vitamin C [18]. Oils present in fruits are from stored in cotyledons of the seeds around 10-12%. Oils extracted from fruit the of fennel contains 22% oleic acid, 4% palmitic acid, 6% petrocyclic acid, 14% linoleic acid. its fruit also contain 5-6% essence with combined ingredients which depends on the location of the plant sown and grown [19]. Some major phenolic compounds are identified in fennel plant includes 3-o-caffeoylquinic acid, eriocitrin, 4-o-dicaffeolquinic acid, rutin, 1,5-o-dicaffeoylqinic acid, 1,3-o-dicaffeolquinic acid and chlorogenic acid [20]. Around more than 35 types of terpene compounds are found in essential oil obtained from fennel plant, 60-80% trans anethole are most important among them and 5% limonene, 8% fenchone are present. Fennel flavonoid constitute eriodictyol-7-rutinoside, quercetin-3-rutinoside with rosmarinic acid.

Uses as traditional medicine

In East Asian countries (India and China) fennel has been used as traditional medicine to treat various diseases. Some famous Greek physicians, Dioscorides and Hippocrates cited fennel as an Emmenagogue and diuretic and its juice was supposed to sharpen the eyesight. The Britishers believed that the plant could offer relief from bloated stomach and facilitated digestion. Romans believed that seeds of fennel could help in supercharging the vision. There has been serious therapeutic use of fennel since 18th century, with many detailed studies and researches. Fennel as a whole is very useful in treating digestive ache and disfunction. Some studies have also revealed its use in the treatment of bronchitis, diabetes, chronic cough and kidney disorders.

Leaves infusion of fennel are widely used to treat infant's stomach-ache and roasted seeds are useful in the treatment of gonorrhea. Fennel powder is also used as a poultice for snake bites in European countries. In women's a hot infusion is used to treat amenorrhea and to improve lactation. In some cases, it is also useful in relieve from vomiting and nausea. Diuretic quality of fennel is helpful in treating kidney and removing obstructions in internal organs like from gut, liver, respiratory and urinary tract. In some studies, it has also shown its effect in treating eye disorders like cataract etc. Many chronic diseases are also treated by the continuous use of fennel seeds.

Pharmacological studies

The pharmacological activities of fennel plants constitute following properties.

Anti-inflamatory activities: In fennel plant anti-inflamatory activity can be noted as a pharmacological property. Methanol extracted from fennel plant has shown the anti-inflamatory activities in many researches. This methanol extract of fennel fruit has shown inhibitory effects on acute and subacute inflamatory disorders. In a research it has been seen that an oral administration of 195 mg per kg of fennel methanol extract can treat central analgesic disorders, and helps in increasing plasma antioxidant enzyme activities and the HDL-cholesterol level. It has also shown to reduce the level of Malondialdehyde (MDA) as a measure to lipid peroxidation. All these research results prove the anti-inflammatory activity of methanol extracted from fennel fruit. In fennel fruit the essential oil extracted from the aerial part has been reported to inhibit 5-lipoxygenase enzyme. Fennel methanol extract has shown greatest anti-inflamatory and anti-oxidant activities, inhibitory pro-inflammatory cytokines production, including Tumor Necrosis Factor-alpha (TNF-α) in Lipopolysaccharides (LPS) stimulated raw cells. Kataoka et al. studies shown the anti-inflamatory effects of fennel contrasting that methanol extract of fennel seeds inhibits the inflammation

through the cyclooxygenase and lipoxygenase pathways.

Antioxidant activities: Oil obtained from fennel plant has shown strong antioxidant activity and can inhibit free radicals due to high content of polyphenols and flavonoids. In studies it has been observed that aqueous fruit extract (AE) demonstrates direct and highly significant *in vitro* nitric oxide scavenging and antioxidant activities. Phenolic compounds obtained from fennel contains such as kaempferol-3-o-glucoside, eriodictyol-7-orutinoside, quercetin-3-o-galactoside performed antioxidant activity. Fennel ethanolic and aqueous extracts as compared to its essence shown less antioxidant activity. The shoots have shown high radical scavenging activity and lipid peroxidation inhibition capacity due to high content of ascorbic acid, phenolics and high content of tocopherol in them, but a contradictory study result. shown that fruits of fennel also contains flavonoids in it too. During early stage of fennel fruit setting stage, top parts contain high amount of phenolics and lower amount of flavonoids which shown higher antioxidant activity in aerial part infusion rather than decoction. Methanol and essential oil extract from fennel have shown to significantly improve activities of antioxidant enzyme and inhibited lipid peroxidation. The essential oil extracted from fennel plant shown higher antioxidant trans-anethole content with maximum antioxidant activities.

Anti-bacterial activities: Fennel extract has also shown bacterial, fungal, viral defensing activity. It is used to treat many mycobacterial infectious diseases. Fruit extract containing acetone is used against *Shigella flexneri*, P*seudomonas aeruginosa*, *Escherichia coli*, *Enterococcus faecalis*, *Staphylococcus aureus* infections. Fennel has also shown antibacterial activity due to presence of some compounds like oleic acid, linoleic acid, undecanal, 2,4-undecadienal, 1,3-benzenediol. This antibacterial activity of fennel is imparted mostly by 5-hydroxy-furanocoumarin. In a study it was found that the extract of this plant shows antimicrobial activity against many bacteria but some strains are resistant to this activity like *Klebsiella pneumoniae* and strains of *Pseudomonas aeruginosa*.

The extract of fennel fruit shown weaker anti-bacterial activity at ambient temperature and shown no activity at boiling water extract instead the acetone extract was found active with significantly lower Minimum Inhibitory Concentration (MIC) value lower than the water extract. Essential oil extracted from fennel plant was also found against certain strains like *S. aureus*, *S. typhimurium*, *E. coli*, *L. monocytogenes*, *E. faecalis*, *P. aeruginosa*, *Staphylococcuss epidemidis*. The alcoholic extract of fennel seed of range 20-80 mg/ml and 5-15 mg/ml shown better antibacterial activity as compared to standard antibiotics. A study by Jazani et al. shown that fennel extract can fight against *Acinetobacter baumannii* strains which causes nosocomial infection. This case study concluded that fennel extract can be used to treat and control multiple bacteria's resistant to antibiotics.

Estrogenic activity: Many experimental researches and studies have revealed the estrogenic activity of fennel plant. Anatole is the main constituent present in fennel which operates the estrogenic activity of the fennel plant. It has found that regular intake of fennel fruit extract has helped in increasing the weight of mammary glands and higher doses leading to more oviduct linings in female rats. In males, different administration of fennel extract has resulted into lower level of testosterone, FSH, LH levels resulting into lower sperm count and epididymis weight loss. In study by Kooti W et al. shown the result that fennel herb estrogenic properties are traditionally used to treat infertile women by increasing the serum concentrations of follicle-stimulating hormone. Concluded that fennel extract shown fewer side effects in the treatment of dysmenorrhea.

Anti-cancer activity: Research studies have shown that methanol extract of fennel had significant anticancer activity on cancerous cells causing cancers of breast cancer and liver cancer by modulating the lipid peroxidation and increasing antioxidant defense system to inhibit the effect on free radicals. They found that methanolic extract of fennel has its effect on antitumor and cytotoxic effects on mice effected with cancer. the cancer cells are suppressed by the anethole responses which is induced by the cytokines which explains its suppressing actions on cancerous cells.

Memory-protective activity: He has reported that fennel plant extract has also shown memory intelligence activity in amnesiac rats. This result shown that fennel extract has memory enhancement property. In some reaches it has been concluded that it can be used to treat cognitive disorders like dementia and Alzheimer. This result shows that fennel has memory increasing property.

Hepato-protective activity: In a recent study showed that the essential oil extracted from fennel are enriched with hepatoprotective activity. As found when these extract of fennel are administered rats whose liver are injured by CCl_4 shown antagonistic activity against it and reduced the level of Aspartate Amino Transferase (AST), Alanine Aminotransferase (ALT), Alanine Phosphatase (ALP) and bilirubin serum. As per this study, it can be concluded that fennel's extracted essential oil probably through its regulatory activity on lipid peroxidation can protect and inhibit hepatic fibrosis.

In another study on fennel extract effects on cytokines in rats affected with hepatic fibrosis. This study revealed that inflammation and degradation reduced in fennel treated group. According to the data obtained from this study it can be deduced that fennel can be used to reduce the inflammation in liver and considerably protect hepatocytes against liver damage. According to Liu YP et al. fennel effect was also studied in TNF-α cytokine in liver fibrosis, this shown that inflammation was reduced and amount of TNF-α was also reduced.

Gastro-protective activity: In recent study that fennel extract has significant effect on gastric ulcer and deduced that the plant has a protective effect on gastric ulcer, additionally it also shown that it can reduce the mucosal lining of the stomach which attributed the anti-oxidant activity of fennel. Later, M et al. investigated and shown that fennel oil emulsion removed the colic disorder in infants.

Anti-diabetic activity: They reported that aqueous extract of fennel is helpful in lowering the blood glucose level and represent the anti-diabetic activities. Also it was found that a

daily intake of fennel aqueous extract can be effective in treating and reducing chronic complications associated with diabetes.

Soud et al. investigated that extracted essential oil of fennel shown hypoglycemics activity in Streptozotocin induced diabetic rats. Essential oil for diabetic mice from hyperglycemias (162.5 ± 3.19 mg/dl) (81.97 ± 1.97 mg/dl) (Activity of serum glutathione peroxide (59.72 ± 2.78 U/g HB) (99.60 ± 6.38) U/ G HB). This produces the possibility of its inclusion in anti-diabetic drug industries.

Cardiovascular regulatory activities: Oulmouden F shown that fennel methanol extract showed that its administration in coronary disorder significantly reduced plasma lipid levels. This shown the anti-cholesterol and anti-atherogenic effects of fennel. Later, it shown that due to its anti-atherogenic and hypolipidemic activity it can be used in controlling cardiovascular disorder.

Abbas, investigated that fennel possess acaricidal activity against D. farina and D. pteronyssinus using the direct contact application and compared with that of the commercial repellent benzyl benzoate. The biologically active constituent of fennel fruit oil has been identified as P-anisaldehyde, (+)-fen chone, (-)-fen chone, thymol and estragol. The biologically active constituents of *Foeniculum vulgare* fruits were characterized as (+)-fen hone and (z)-9-octadecanoic acid.

Available research studies and experiments have shown various pharmacological properties of *Foeniculum vulgare* which includes anti-histamine, anti-inflammatory, anti-cancer, anti-oxidant, anti-bacterial, anti-stress and cytotoxicity activities. The chemical constituents of this plant posses all these various pharmacological properties. Phenolic compounds and essence of this plant are most active and perform medicinal activities. All thee bioactive compounds can be used to produce various cosmetics products. The most prominent and advance studies of this plant include the anti-oxidant, anti-bacterial, anti-histaminic effects in various experimental models. The most advance and broad area exploring new dimensions in drug l are of anti-cancer effect shown by the fennel plant. This dimension needs future research to be investigated widely and deeply to explore more about this plant (Table 2).

Table 2: Available research studies and experiments.

Study	Intervention	Control	How to use	Results	Adverse effects
Nazarpour and Azimi	Fennel oil oral drop (n=36)	Mefenamic acid (n=36) or placebo (n=32)	20-30 drops of fennel oil oral drop or placebo every 4-8 h, or mefenamic acid capsule (250 mg) every 6 h from the beginning of pain during two menstrual cycles	No significant difference in menstrual clinical symptoms after the first cycle. Improvement in menstrual clinical symptoms after second cycle.	-
Delaram and Jafari	Fennel oil (n=28)	Placebo (n=27)	20 drops of fennel oil oral drop (2%) in three divided doses, three days before and after of menstruation for two periodic cycles	↓ Severity of anxiety, depression and total clinical symptoms No effect on excitement, fluid accumulation and physical signs of PMS (P>0.05)	No adverse effects
Omidali	Fennel oil (n=10)	Pilates exercises plus fennel (n=10) Pilates exercises (n=10) Control (n=10)	30 drops of fennel oil oral drops (2%) every 12 h for one month	No effect on mood and behavioral symptoms (P=0.306) Higher effect on physical symptoms	-
Pazoki et al.	Fennel oil	Aerobic exercise, fennel plus aerobic exercise, and control groups	20 drops of fennel oil oral drop (2%) in three divided doses, three days before and after of menstruation for two periodic cycles	↓PMS severity ↓ anxiety and depression	-

State wise production of fennel in India

Different state wise fennel production is shown in Table 3.

Table 3: Some important uses of fennel in Ayurvedic medicines.

		2015-16	
Sr no.	**State**	**Production**	**Share (%)**
1	Gujarat	96.77	74.81
2	Rajasthan	30.72	23.75
3	West Bengal	1.03	0.8
4	Uttar Pradesh	0.67	0.52
5	Haryana	0.17	0.13
	Page Total	129.36	-

Some important uses of fennel in Ayurvedic medicines

- In pregnant woman's and nursing mother, the leaves or seeds boiled in Barley-water are good for lactation increments.
- Decoctions of fennel and its seeds are good to break stone and provoke urine and eases the pain of kidney stones.
- Leaves, or the seeds, boiled in water helps in soothing stomach of sick and feverish persons.
- The seed, or roots. Help to open the obstructions of the liver, gall. Spleen, and cure the windy swellings and yellow jaundice, gouts and cramps.
- The seeds, leaves and roots are much used in drinking to make people lean that are too fat.
- Fennel seeds are used to improve bad breath and body odor that is caused by the intestine malfunction.
- Fennel decoction are best used for relieving from bloating and digestive aids.
- Fennel oils are traditionally rubbed over painful joints to relieve pain from cramps, colic, and spasms.
- It is also used as mosquito repellent, and be more acceptable choice for indigestion for cats and dogs.
- Fennel decoction are also used for cleaning eyes and cures eye infections.

Commercial applications

- Fennel seeds are a common cooking spice, especially in cooking fish. Its tea is also helpful in treating insect bites and food poisoning.
- Taking a cup of fennel seed decoction before a heavy appetite or meal can help in easy digestion.
- Oil obtained from fennel seeds are used for curing rheumatic pains and in soothing the swelling.
- The fresh stems of fennel are eaten much like celery, seeds are used as flavorings agent in fish dishes and other common dishes.
- Fennel tea are used to cure from chronic coughs from lungs, syrup prepared from fennel are used to increase immunity also.
- These fennel seeds and stems are also used for cattle condiments.
- Fennel water mixed with bicarbonate and syrup; this water constitutes the domestic 'Gripe Water' which is commonly used to cure the flatulence of infants.

Conclusion

Fennel various pharmacological properties and bioactive molecules play important and significant in human health. According to small clinical studies on few patients revealed several important clinical effects. As these studies were not very wide ranging and adaptive to large peoples it would not be sufficient to make them conclusive.

References

1. Tang SY, Halliwell B (2010) Medicinal plants and antioxidants: what do we learn from cell culture and *Caenorhabditis elegans* studies?. Biochem Biophys Res Commun 394:1-5
2. Endalamaw FD, Chandravanshi BS (2015) Levels of major and trace elements in fennel (*Foeniculum vulgari* Mill.) fruits cultivated in Ethiopia. SpringerPlus 4:1-10
3. Kooti W, Asadi-Samani M (2014) The effect of Halcoholic extract of celery leaves on the delivery rate (fertilization and stillbirths), the number. Adv Environ Biol 8:824-830
4. Beyrami-Miavagi A, Farokhi F, Asadi-Samani M (2014) A study of the effect of prostodin and hydroalcoholic extract of *Malva neglecta* on kidney histopathology and renal factors in female rats. Adv Environ Biol 942-948
5. Kooti W, Mansouri E, Ghasemiboroon M, Harizi M, Ashtary-Larky D, et al. (2014) The effects of hydroalcoholic extract of *Apium graveolens* leaf on the number of sexual cells and testicular structure in rat. Jundishapur J Nat Pharm Prod 9
6. Asadi-Samani M, Rafieian-Kopaei M, Azimi N (2013) Gundelia: a systematic review of medicinal and molecular perspective. Pak J Biol Sci 16:1238-1247
7. Kooti W, Ghasemiboroon M, Asadi-Samani M, Ahangarpoor A, Abadi A, et al. (2014). The effects of hydro-alcoholic extract of

celery on lipid profile of rats fed a high fat diet. Adv Environ Biol 8:325-330

8. Asadi-Samani M, Kafash-Farkhad N, Azimi N, Fasihi A, Alinia-Ahandani E, et al. (2015) Medicinal plants with hepatoprotective activity in Iranian folk medicine. Asian Pac J Trop Biomed 5:14657
9. Kooti W, Mansori E, Ghasemiboroon M, Harizi M, Amirzarga A (2014) Protective effects of celery (*Apium Graveolens*) on testis and cauda epididymal spermatozoa in rat. Iran J Reprod Med 12:365-366
10. Abe R, Ohtani K (2013) An ethnobotanical study of medicinal plants and traditional therapies on Batan Island, the Philippines. J Ethnopharmacol 145:554-565
11. Amshidi E, Ghalavand A, Sefidkon F, Goltaph E (2012) Effects of different nutrition systems (organic and chemical) on quantitative and qualitative characteristics of Fennel (*Foeniculum valgare* Mill.) under water deficit stress. Iran J Med Aromat Plants 28:309-323
12. Birdane FM, Cemek M, Birdane YO, Gulcin I, Buyukokuroglu ME (2007) Beneficial effects of *Foeniculum vulgare* on ethanol-induced acute gastric mucosal injury in rats. World J Gastroenterol 13:607
13. Delaram M, Kheiri S, Hodjati MR (2011) Comparing the effects of echinop hora-platyloba, fennel and placebo on pre-menstrual syndrome. J Reprod Infertile 12:221-226
14. Pourabbas S, Kesmati M, Rasekh A (2011) Study of the the anxiolytic effects of fennel and possible roles of both GABAergic system and estrogen receptors in these effects in adult female rat. Physiol Pharmacol 15:134-143
15. Bernath J, Nemeth E, Kattaa A, Hethelyi E (1996) Morphological and chemical evaluation of fennel (*Foeniculum vulgare* Mill.) *populations of different origin.* J Essent Oil Res 8:247-253
16. Ahmadi A, Nasiri Nejad F, Parivar K (2007) Effect of aqueous extract of the aerial part of the *Ruta graveolens* on the spermatogenesis of immature Balb/C mice. Razi J Med Sci 14:13-20
17. Meireles MA (2005) Supercritical fluid extraction from fennel (*Foeniculum vulgare):* global yield, composition and kinetic data. J Superscript Fluids 35:212-219
18. Rather MA, Dar BA, Sofi SN, Bhat BA, Qurishi MA (2012) *Foeniculum vulgare:* A comprehensive review of its traditional use, phytochemistry, pharmacology, and safety. Arab J Chem
19. Miguel MG, Cruz C, Faleiro L, Simões M, Figueiredo AC, et al. (2010) *Foeniculum vulgare* essential oils: chemical composition, antioxidant and antimicrobial activities. Nat Prod Commun 5:319-328
20. Salehi Surmaghi H (2006) Medicinal plants and phytotherapy. 59-63