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Fennel: A Medicinal Spice.

[1*]Girase Nilesh Vijaysing, [2]Dolnar Vaishnavi R, [3]Gite Shashikant S, [4]Nikam Prafulla M, [5]Darekar Avinash B, [6]Badgujar Vaishnavi C.Department of Pharmacognosy

K.V.N.N. SPS's Institute of Pharmaceutical Education and Research, Nashik.

ABSTRACT: **Foeniculum Vulgare Mill is commonly known as Fennel. The fennel belongs to the family Apiaceae, a small, erect aromatic herb. Foeniculum vulgare is a medicinal plant which used to treat various diseases. A plant largely grown as a herb or for its fruit and valued for its Pleasant aroma, and abundant nutritional and medicinal properties. This study shows the use of fennel in the treatment of various diseases, such as cancer, fever, abdominal pains, flatulence, gastralgia, gastritis, insomnia, liver pain, mouth ulcer, Stomach ache & another purpose. Fennel seeds have been shown a potential drug for the treatment of hypertension. This is a well-known and important medicinal plant widely used in several indigenous systems of medicine for various therapeutic benefits viz. Hepatoprotective activity, Antidiabetic activity, cardiovascular, Gastro-protective, Estrogenic, Hypolipidemic. Fennel is also used as an antioxidant in the preservation of food.**

Keywords: **Foeniculum vulgare, Fennel, Essential oil.**

INTRODUCTION:

Foeniculum vulgare Mill. is a biennial healthful and aromatic plant belonging to the family Apiaceae (Umbelliferaceae).[1] It's a hardy, perennial-umbelliferous herb with yellow flowers and feathery greenleaves. It grows to a height of up to 2.5 m with concave stems. Leaves grow 40 cm; they're finely cleft with the last section filament-like (like thread) of roughly 0.5 mm wide. Flower terminals area unit created in compound umbels. The fruit may -be a dry seed 4-10 mm long. [2]

During the thirteenth century in European nations, fennel was thought of as a royal spice andwas served to kings with fruit, bread, and dishes like preserved fish seasoned with fennel seeds.[3] It may be adult on marginal land and is taken into account and tolerant to varied insect pests and diseases. It's acknowledged for having healthful medicinal properties and it's especially used as a remedial measure for flatulence.[4] Fennel is conventionally used for healthful and edible purposes. The whole plant is efficacious within the pharma industry; its enlarged base is employed as a vegetable, its leaves area unit used for edible purposes, and its seeds as a spiceand for essential oil extraction.

The flowers and leaves are wont to create yellow and brown dyes. Fennel spore is the most potent type of fennel, however, it's extraordinarily costly.[3] Fennel fruits are used as TCM for the treatment of infants tormented by dyspeptic disorders in China for hundreds of years.[5] Plant seeds may be processed into top-quality vegetables or essential oils, the remaining portion might notice varied profitable applications becauseof their phytochemicals content and antioxidant activity. These by-products will so be seen as economically promising raw materials for Future applications in industrial products for pharmaceuticals or cosmetics.[6]

HISTORY:

Fennel is another herb with a history of medicinal, magical, and edible uses. Fennel was used bythe ancient Egyptians as food and medicine and was considered a snake bite remedy in ancient China. During the middle ages, it was hung over doorways to drive away evil spirits.

Fennel is associated with the origin of the marathon.[7]

TAXONOMY OF FENNEL: [8]

Fig 1- Taxonomy of Funnel

CHEMICAL CONSTITUENT: [9]

Table 1- Chemical composition of Funnel

Sr. No	COMPOSITION	CONTENT
1	Moisture	6.3 g
2	Protein	9.5 g
3	Fat	10.0 g
4	Carbohydrate	42.3 g
5	Crude Fiber	18.5 g
6	Mineral matters	13.4 g
7	Calcium	1.3 g
8	Phosphorus	0.48 g
9	Iron	0.01 g

10	Sodium	0.09 g
11	Potassium	1.7 g
12	Vitamin A	1040 I.U.
13	Vitamin B-1	0.41 mg
14	Vitamin B-2	0.36 mg
15	Niacin	6.00 mg
16	Vitamin C	12.00 mg
17	Food energy	370 Calories

EXTRACTION METHOD OF FENNEL SEED OIL:

1] By Steam Distillation:[6]

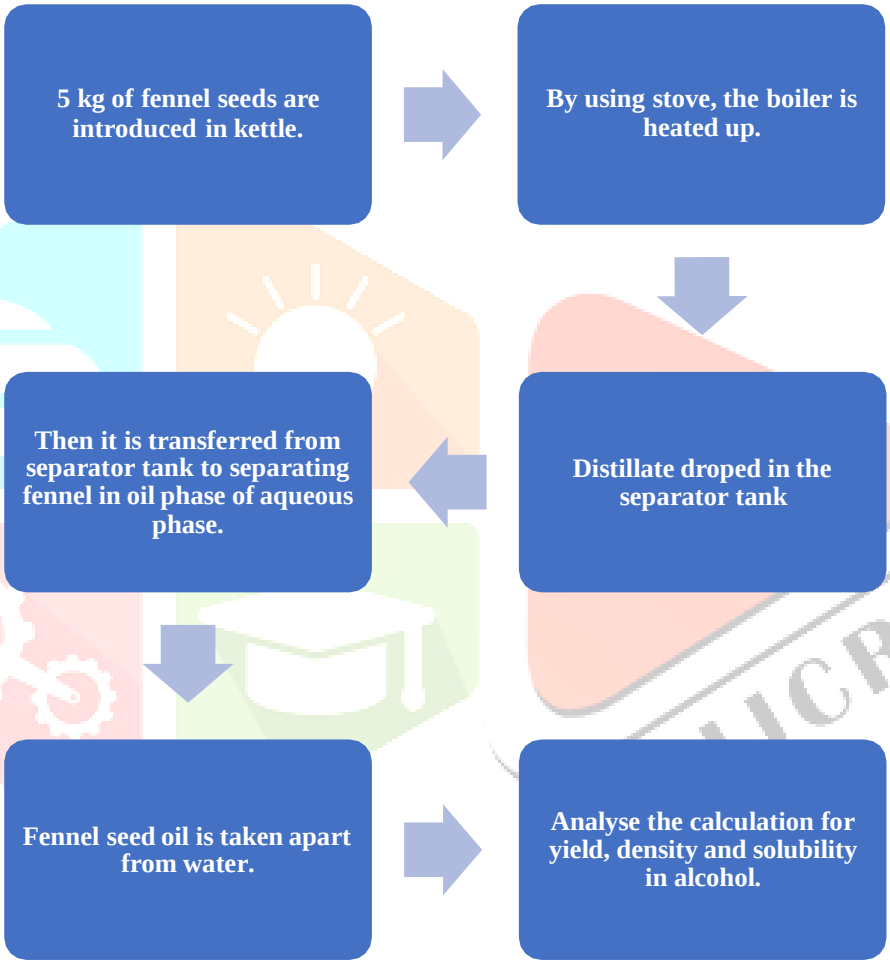

Fig 2- Extraction process of Fennel oil by steam distillation.

FORMULA TO CALCULATE YIELD OF FENNEL SEED OIL:

$$\text{Yield of Fennel seed oil} = \frac{\text{Mass of Fennel seed essential oil distillation}}{\text{Distilled Fennel seed mass}}$$

It is expressed in % by weight.

2] By using Hydro distillation:[10]

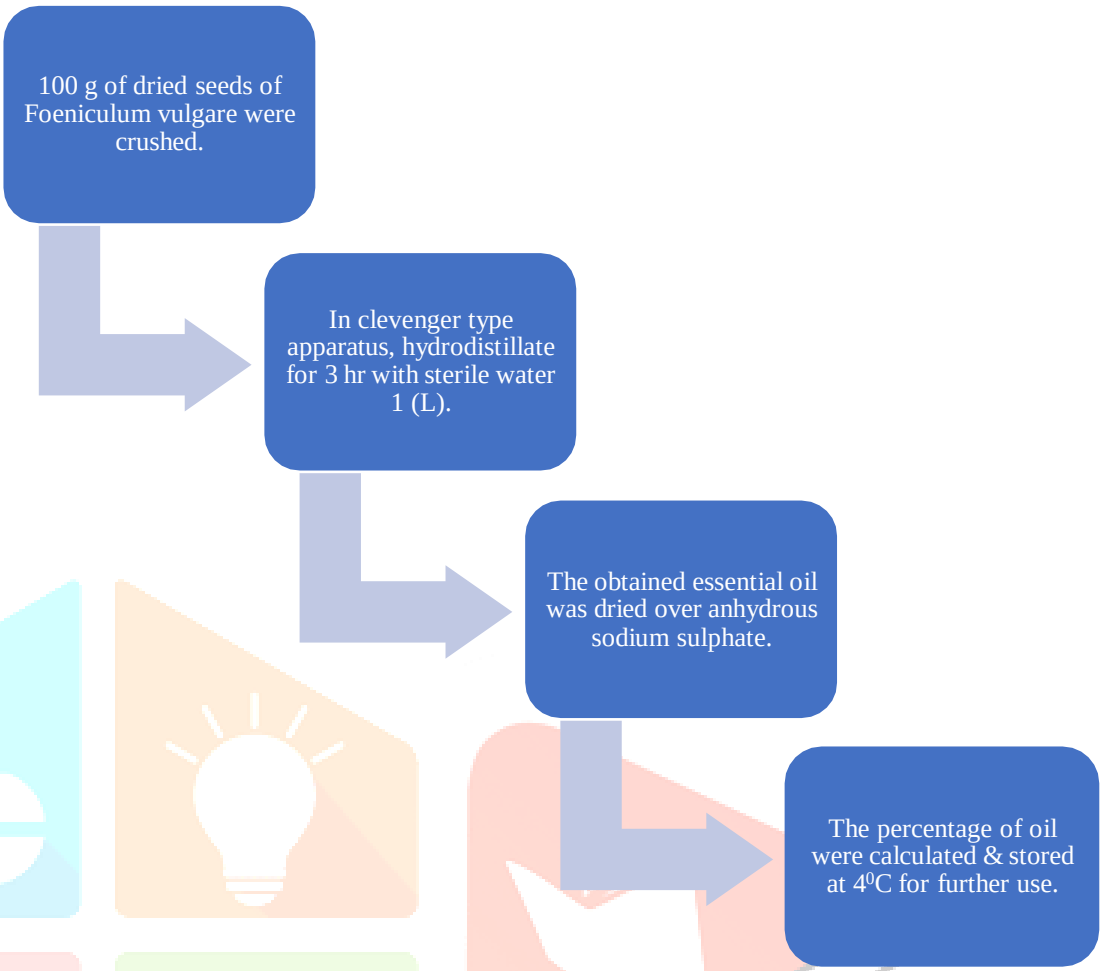

Fig 3- Extraction process of Fennel oil by hydro-distillation

Physicochemical properties of fennel seed oil:[9]

Table 2- Physicochemical properties of fennel seed oil

PROPERTIES	VALUES
Colour	Clear, Pale yellow
Specific gravity at 25^0 C	0.978 to 0.988
Optical rotation	(-2)-10
Refractive index at 25^0 C	1.55
Solubility in alcohol 90%	Perfectly soluble (1:3)

Activity of Foeniculum vulgare Mill:

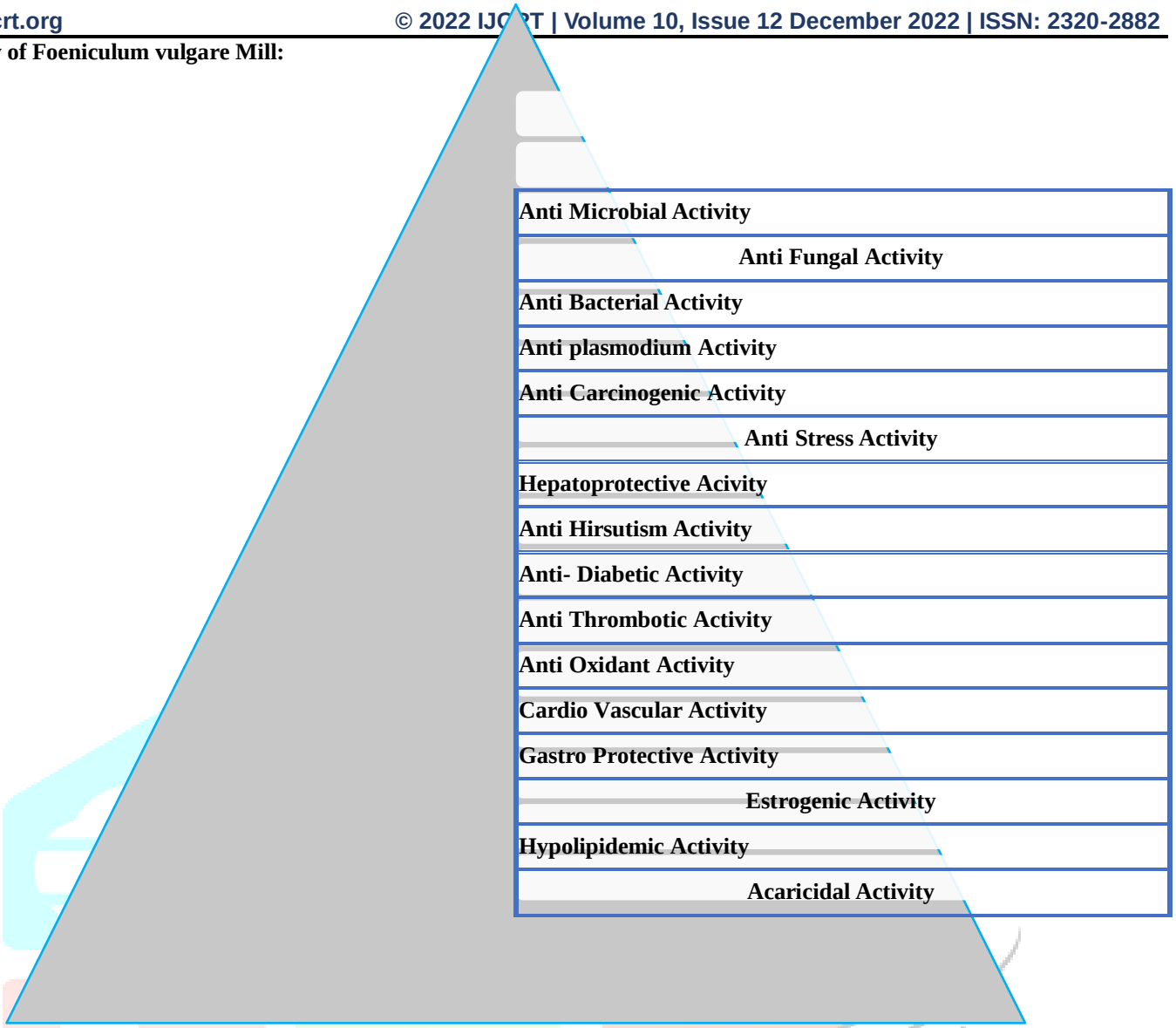

Fig 4 - Activities of Foeniculum vulgare Mill

1) Antimicrobial Activity:

Antibacterial activity of waterless and organic Foeniculum vulgare seed excerpts was assessed against Enterococcus faecalis, Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Salmonella typhi, Salmonella typhimurium, Shigella flexneri, using agar prolixityassay. The antimicrobial effect of the methanol, ethanol, diethyl ether, and hexane excerpts of the seed of Foeniculum vulgare was delved against Escherichia coli, Salmonella typhi Bacillus cereus Staphylococcus aureus, Candida albicans and Aspergillus flavus Methanolic excerpt showed more antimicrobial exertion than the other excerpts.[8] The chloroform answerable bit from the stems of fennel displayed a potent antimicrobial exertion against bacteria and fungi.[5] An waterless portion of the ethical part of F. Vulgare prevented the maturation of Agrobacterium radiobacter PV. tumefaciens, Erwinia carotovora, Pseudomonas fluorescens, and Pseudomonas glycinea.[11] Theleaves of Florence fennel, agrarian wastes, could be used to recover anethole from being used for its seasoning and biomedical parcels.[12] The ambient temperature water excerpt showed weaker antibacterial exertion, whereas the exertion was fully lost in the scorching water excerpt and the acetone excerpt was active with significantly lower Minimum Inhibitory Concentration(MIC) values than the water excerpt.[13]

2) Antifungal Activity:

The vital oil of F. Vulgare has additionally been said to lessen the mycelial increase and germination of Sclerotinia sclerotiorum and as such may be used as bio fungicide opportunity to artificial fungicides towards phytopathogenic fungi.[1] Essential oils of F. Vulgare, anethole, fenchone and camphor confirmed antifungal sports towards C cladosporioides, Penicillium helianthi and Trichophyton mentagrophytes, in comparison with a fashionable mycotoxic bifonazole, Penicillium ochrochloron, Penicillium funiculosum andTrichoderma viride have been the maximum resistant species.[5] The important parts of the oils have been: (E)- anethole (72.27%-74.18%), fenchone (11.32%-16.35%) and methyl chavicol (3.78%- 5.29%).(8)F. vulgare oil exercised various capabilities of anti-fungal consequences on Alternaria alternate's experimental mycelial increase. The fennel oil concentrations of forty ppm constitute an inhibitory effect on the mycelial increase of A. Alternaria however 10 ppm turned into unworkable.[14] The Fennel vital oil is powerful as an antifungal agent towards Candida albicans and Aspergillus.[12] The antibacterial and antifungal interest has been said similarly for azoricum and dulce cultivars and piperitum cultivars.[3] antifungal sports of aqueous and dichloromethane: methanol (1:1) root and root bark extracts of P. prunelloides the use of the microtiter assay towards dermatologically applicable pathogens including Candida albicans, Microsporum canis, and Trichophyton mentagrophytes

with amphotericin B as a tremendous control.[15] In an in vitro study, fungal and aflatoxin infection in saved tobacco leaves and the capability of Foeniculum vulgare (fennel) seed vital oil as a plant- primarily based totally preservative in safety tobacco throughout garage turned into tested and it confirmed that the fennel vital oil can, for this reason, be formulated as plant-primarily based totally preservatives for meals items.[2]

3) Antibacterial Activity:

Fennel essential canvases have an antibacterial effect. The bacteriostatic goods of the crude excerpt deduced from fennel have been proven against Helicobacter pylori, the most current gastric pathogen causing gastric dysfunction, ulceration and indeed cancer.[3] A significant antibacterial exertion. as determined with the agar prolixity system, was shown by C sativum essential oil painting whereas an important reduced effectwas observed for F Vulgare oil painting.C. sativum and F Vulgare essential canvases may be useful natural bactericides for the control of bacterial conditions of shops and for seed treatment, in particular, in organic husbandry. A phenylpropanoid outgrowth, dilational was set up to be an antimicrobial principle of the stems of FVulgare with MIC values of 125, 250 and 125/ against Bacillus subtilis, Aspergillus niger and Cladosporium cladosporioides, independently.[4] Fennel has 5- hydroxy- furanocoumarin which has an important part in antibacterial exertion.[2] The essential oil painting uprooted from the fruits of F. Vulgare exhibited an antibacterialeffect against foodborne pathogens similar to Escherichia coli, Bacillus megaterium and Staphylococcus aureus.[1]

4) Antiplasmodium Activity:

Fennel is a superb abdomen and internal organ remedy for treating flatulence and intestinal colic conditions, whereas additionally stimulating healthy appetence and digestion/Fennel seeds to increase epithelial duct motility and act as a medicament in high doses Fennel extracts turn out a reduction in acetylcholine-induced contraction and reduce most possible ability. A fennel extractive, peppermint and ginger in an enteric- coated exhausting gelatin capsule also are offered on the market, to treat discomfort, abdominal hurting and epithelial duct illness. There area unit five commercial- Ayurvedic products Satapuspadi churana, Salapushpa arka, Satapushpadya Ghrita Abhayrishta and Panchsakar churna, that are prescribed by Ayurvedic practitioners to enhance digestion, manage intestinal colic pain and different epithelial duct issues.[3] The antispasmodic activity of 2.5 and 10.0 mL/L of alcoholic extract of Foeniculum vulgare Stong with different Germanic medicative plants, namely. melissa officinalis, Rosmarinus officinalis, Mentha piperita, Matricaria Samomilla, Carum carvi, and citrus Aurantium were tested using the guinea pig small intestine and exploitation acetylcholineand histamine as spasmogens.[11]

5) Anticarcinogenic Activity:

Cancer may be a factor disorder gene disease abnormal cell division and injury of body tissue. F. Vulgare has steroid hormone, lactagogue, diuretic, and immune booster properties that create an anticarcinogenic study necessary.[14] The most content of fennel oil, anethole, shows malignant tumour activity.[12] The anticarcinogenic potential of anethole was studied in bacteriologist pathology growth (EAT) within the paw of Swiss anomaly mice The results discovered that anethole inflated the survival time, cut back the tumour weight and volume and the effects of the EAT-bearing mice.[8] The consequences of anethole are alsomediated by the modulation of the neoplasm death issue (TNF)-induced cellular responses. Anethole might interfere with tumour necrosis factor sign and result in the activation of NF-κB, AP-1, JNK, apoptosis and apoptosis. Anethole could suppress NF-kB-dependent gene expression evoked by tumour necrosis factor (NF-kBcontrols the expression of some genes concerned with carcinogenesis and inflammation.[3] In a different study, methanolic extract of fennel has effects on antineoplastic and cytotoxic activities in mice with cancer.[2]

6) Antistress Activity:

Drugs and food of natural origin play a major role in publicly aid systems and area units being investigated as remedies for a number of stress-related disorders.[11] F. Vulgare is also helpful in the management of stress and stress-related disorders on account of its multiple actions like antistress, memory-enhancing, and antioxidant effects.[12] The anti-stress and memory-enhancing properties of Foeniculum vulgare boiling water extract (50, 100 and 200 mg/kg, orally) were studied in experimental rats. Urinary levels of vanillylmandelic acid(VMA) and water-soluble vitamins in rats were used to evaluate anti-stress activity.[8]

7) Hepatoprotective Activity:

As well as being a useful treatment for chest, spleen and kidney diseases, fennel fruit also has liver protection properties.[3] Liver is a vital organ which detoxifies various metabolites and Secrets out xenobiotics from the body. Hepatoprotection is a chemical substance capable of preventing liver damage. The hepatoprotective property of Vulgare essential oil was examined in rats using a carbon tetrachloride-induced liver fibrosis model. The hepatotoxicity generated by chronic carbon tetrachloride administration was found to be inhibited by the F Vulgare essential oil with confirmation of reduced Levels of serum aspartate and alanine aminotransferase. bilirubin and alkaline phosphatase.[14]

8) Anti-hirsutism Activity:

Idiopathic hairiness is outlined because of the prevalence of excessive male pattern hair growth in ladies WHO have traditional|a traditional|a standard} ovulatory oscillation and normal levels of blood serum androgens. it's going to be a disorder of peripheral steroid metabolism.[12] Historically, fennel has been used as an associate sex hormone agent. it's been putative to extend milk secretion, promote flow, facilitate birth, and increase sexual desire. On considering the top facet, Javidnia and his analysis team evaluated the anti-hair-autism activity of ethanolic extract of F. vulgare seed against upset hairiness by getting ready to a cream containing one and a pair of fennel extracts. The efficaciousness of treatment with the cream containing two fennel is best than the cream containing I Chronicles fennel and these 2 were harder than the placebo (control group).[11]

9) Antidiabetic Activity:

Diabetes mellitus could be a chronic malady because of inaccurate hypoglycemic agent action related to associate abnormal high glucose concentration. 3 specific n-butanol, ester and aromatic hydrocarbon extracts of Vulgare seeds screened with a-amylase and a-glucosidase inhibition assay for his or her medicine activity in vitro. The results are incontestable compared with the quality acarbose values. these 3 extracts contained high a-glucosidase repressing impact than a-enzyme.[14] Fennel was historically reported to be extremely suggested for individuals with polygenic disorder. The volatile oil gift in Foeniculum vulgare possesses associated medicine impact in Streptozotocin-Induced Diabetic Rats.[12] The results showed that fennel extract improves hyperglycemia in diabetic rats a part of this is associated with herb impact on oxidation/restored system.[2]

10) Antithrombotic Activity:

Fennel found that the oil of F. vulgare and its main part, anethole has been shown to possess a certain antithrombotic activity that originates through their broad-spectrum anti-platelet activity, clot destabilizing effect and vasorelaxant action. Anethole prevents thrombin-driven refuse reaction at concentrations like phenyl oil.[2] In vivo, F Vulgare oil and anethole were administered orally in mice through a subacute treatment (30 mg/kg per day for 5 days) to demonstrate antithrombotic potential preventing the disorder induced by collagen-epinephrine shot (70% and 83 %protection, respectively). At the antithrombotic dose, they were free from hemorrhagic side effects, in disorder with acetylsalicylic acid used as a reference drug.[14]

11) Antioxidant Activities:

Naturally-occurring antioxidants are used to protect human beings from oxidative stress damage. Fennel was called the epic source of natural antioxidants and contributed to the daily antioxidant diet.[5]The antioxidant activity of natural, edible and nutritional fennels from completely different Mediterranean countries has been determined. Wild fennel has been found to exhibit a radical scavenging activity over that of each medicinal and edible fennel.[1] Essential oils from the azoricum and dulce cultivars were more effective antioxidants than Those from the Vulgare cultivar.[12] The oil showed strong antioxidant activity compared with butyrated hydroxyanisole and butylated hydroxytoluene.[11] Fennel has antioxidant properties. Due to the high content of polyphenols and flavonoids, this plant will stop free radicals. Phenolic compounds in this herb like as caffeoylquinic acid, rosmarinic acid, eriodictyol-7-orutinoside, quercetin 3-0-galactoside, and kaempferol-3-0- glucoside showed antioxidant activity.[2]

12) Cardiovascular Activity:

An aqueous extract of F Vulgare leaves influences possible cardiovascular action. This effect was inspected using pentobarbital-anaesthetised male albino Sprague-Dawley rats. An intravenous administration of the lyophilized heated water extract of leaves developed a significant dose-related depletion in arterial blood pressure, without affecting the heart rate or respiratory rate.[11] It is one of the commonly used plants to lower blood pressure that acts by causing diuresis, increasing the excretion of sodium and water from the body.[13]

13) Gastro-Protective Activity:

Fennel plant has an important protective effect on gastrointestinal disorders. The discovery showed that the plant had a preventive effect on the gastric ulcer.[2] Oral administration of essential oil and anethole is also significantly protective against ethanol-induced gastric lesions in rats. The antioxidant action of phenol contents is partly assign for the anti-ulcer action.[13] This effect of aqueous extract was highest and statistically significant in the 300 mg/kg group compared with the control ($P < 0.001$) group of animals.[11] The gastric ulcer protective potential of an aqueous suspension of Foeniculum vulgare was evaluated against different acute gastric ulcer models, pyloric ligation (Shay), hypothermic restraint stress, indomethacin and by necrotizing agents (80% ethanol, 0.2 M NaOH and 25% NaCl). Pretreatment with Foeniculum vulgare suspension, 250 and 500 mg/ kg by orally (intraperitoneally in the Shay rat model) showed dose-dependent ulcer protective effects inall the models.[8]

14) Estrogenic Activity:

Since the finding of the estrus-make effects of some plant products in 1926, significant effort has been constant towards the assuming of phytoestrogens, making flavonoids, isoflavonoids, chalcones, coumestans, stilbenes, lignans, saponins, and essential oils. Fennel oil was noted to show estrogenic activity. motivate menstruation and alleviate the indication of female climacteric, and improve libido.[11] Foeniculum vulgare seed is used for polycystic ovarian syndrome (PCOS) treatment with phytoestrogen compound present in it.[14] It maybe used for the alleviation of dysmenorrhea sequelae.[5]

15) Hypolipidemic Activity:

F.Vulgare demonstrated hypolipidemic activity and therefore can be used for the prevention of cardiovascular diseases. It is strongly suggested that fennel should be used in diets for patients with hyperlipidemia or those with a family history of hyperlipidemia. It effectively decreases the deposition of triglycerides in the form of fatty liver and facilitates blood motion in coronary arteries by blocking the depositionof lipids in the light of coronary arteries by reducing serum and liver lipids.[14] Aqueous extract causes a significant reduction of plasma lipid levels, that is, cholesterol, triglycerides, LDL- cholesterol, and apolipoprotein-B decreased by 40%, 23%, 61%, and 61%, respectively, and increase in HDL-cholesterol and apolipoprotein Al by 85% and58%, respectively.[11]

16) Acaricidal Activity:

The fennel possesses Acaricidal activity against D. farina and D. pteronyssinus utilising immediate contact implementation and compared with that of the marketable repellent benzyl benzoate.[2] The methanol extract of F. vulgare fruit has been noted to show mosquito-repellent effect towards Aedes aegypti females using skin and patch tests.[1] Extracts of fennel were toxic against Culex pipiens larvae, and terpineol and 1,8-cineole were the most effective components against Anopheles virus and Aedes aegypti, which suggestedfennel was an alternative use of synthetic insecticides.[5]

CONCLUSION:

From the above information, it is concluded that the Foeniculum Vulgare is a plant that has a broad range of chemical components and several pharmacological properties. Fennel has been used as food and medicine for long history. The bioactive fennel molecule can be used in the production of drugs. It provides a knowledge basis in pharmaceutical activities to develop/formulate new drugs and future clinical use. Fennel is used for the purpose of antioxidants as preservatives in food. The fennel has potential beneficial therapeutic actions in the management of bacterial & fungal infections and colic pain. Fennel is widely used in the treatment of hypertension as a potential drug.

The Fennel is also used for its flavor and nutraceutical properties. Another beneficial use of fennel is a significant protective effect on gastrointestinal disorders. The fennel has several pharmacotherapeutic benefits inthe treatment of system-related diseases. It was concluded fennel is a suitable medicinal plant and it will be helpfulfor further researchers to get information.

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