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The Pharmacological Potential of *Anethum graveolens*: A Review of Therapeutic Applications

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Abstract: *Among the several physiologically active substances found in Anethum graveolens were essential oils, fatty acids, proteins, carbohydrates, furanocoumarin, polyphenols, minerals, and more. It is frequently applied in conventional contexts. According to pharmacological studies, Anethum graveolens produced a number of functions, including antibacterial, anti-inflammatory, analgesic, smooth muscle relaxant, gastric mucosal protective and antisecretory, hyperlipidemia, raised progesterone concentration, and more. The chemical components and pharmacological actions of Anethum graveolens will be the main topics of this review.*

Keywords: *Anethum graveolens*, Dill, chemistry, Pharmacology

I. INTRODUCTION

Anethum graveolens L. is an evergreen plant. It is derived from Greek word aneeson or aneeton, which means strong smelling. It grows up to 90 cm with slender stems and leaves divided into pinnate sections, broader than fennel. Its yellow flowers form umbels, and its "seeds" are actually schizocarps—small, dry fruits split into halves. Dill fruits are oval, winged, and have longitudinal ridges and oil cells. Their taste is similar to caraway, but dill seeds are smaller, flatter, lighter, and have a pleasant aromatic odor.[1]

Botanical Classification:
Synomyms: Selinum anethum Roth, Peucedanum graveolens Benth., and Pastinaca anethum Spreng.
Common Names: include Soyaa in Unani, Sadakuppai in Siddha, Sowa in Hindi, Soya in Punjabi, Dill and Anet in English, and Shibth and Haba helwa in Arabic.
Components utilized in medicine: Leaves, fruit, and essential oils.
Kingdome: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Apiales
Genus: Anethum
Family: Apiaceae (Umbelliferae)
Subfamily: Apioideae
Species: *Anethum graveolens*
Cultivation and Collection: Annual or biennial herb that thrives in well-drained loose soil with full sunlight.It can handle pH values between 5.3 and 7.8.It need warm to hot summers with high levels of sunshine;even a little bit of shade will significantly limit the output.In dry weather,the plant quickly runs out of seeds.When grown in a proper position,it frequently self-sows.Plants reproduce by means of seeds.[2]
Medicines:
Dill has been traditionally used in herbal medicine for its carminative (relieving flatulence) and digestive properties.
Dill seeds and leaves are used to treat issues like indigestion, stomach cramps, and flatulence.
Dill water (a preparation made by steeping dill seeds) is commonly used to soothe colic in infants.

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Dill may also have mild diuretic, antimicrobial, and antioxidant properties. Some cultures use it to freshen breath, relieve hiccups, or as a sleep aid.

Traditional uses-remedy for indigestion and flatulence, milk secretion stimulant, anticonvulsant, anti-anxiety, antiemetic, anti-cramp, wound healer to increase the appetite, strengthen the stomach.

Pharmacological uses- antimicrobial, anti-ulcer, antibacterial activity, antifungal, anti-inflammatory and analgesic, mucosal protective and anti-secretory effects, inhibited acetylcholine relief digestive problems.[3]

Medicinal Species:

The Greek term aneeson, or aneeton, which means strong-smelling, is the source of the genus name Anethum. In India, it is referred to by a number of names, including Shatapushpa in Sanskrit, Shulfa in Hindi, Shepu in Marathi, and Suva in Gujarati. Dill is used in Ayurvedic medicine to alleviate digestive problems, colic, and stomach pain. It is said to heal kapha, vata, ulcers, and uterine difficulties. It also possesses qualities like usnavirya and katutikta rasa. While Kashyapasamhitaa commended its revitalizing and intellectually stimulating properties, Charaka suggested using it to treat joint swellings. Native to Southwest Asia or Southeast Europe, *Anethum graveolens* has been used medicinally since ancient Egypt and Rome and is used in more than 56 Ayurvedic formulas. Since dill grows well in colder, drier climes, it is typically grown in winter (rabi) in India (Rajasthan, Maharashtra, Madhya Pradesh, and so forth). The herb complements cabbage, corn, onions, and lettuce. Anethum seeds are used as a spice, while its dried and fresh leaves—also known as dill weed—are used as a condiment and to prepare tea. This aromatic herb is commonly used to flavor and season a variety of foods, including sauces, pickles, salads, and soups. The plant's seeds, leaves, and stems are used to make dill oil, which includes essential oils used in the culinary industry for seasoning. It also serves as caraway oil in perfumery and is used to scent soaps and detergents.[4]

Table No. 1:- Anethum graveolens plant parts, chemical components, and applications [5-8]

Sr. No.	Parts of *Anethum graveolens* plant	Chemical Constituents	Applications
1.	Seeds	Carvone Limonene Anethole Dillapiole Phenolic compound	Spice, carminative, treat indigestion, colic and bloating, antimicrobial properties, antioxidant activity.
2.	Leaves	Carvone Limonene Flavonoids Phenolic acids Essential oils	Flavor dishes, reducing bloating and gas, anti-inflammatory benefits, mild sedative effects, antioxidant properties -protect against cellular damage, antibacterial properties.
3.	Roots	Carvone Limonene Anethole Flavonoids Phenolic compound	Herbal remedies for digestive issues, treating urinary problems, inflammation
4.	Flowers	Carvone Limonene Flavonoids-quercetne and kaempferol	Flavouring pickles, preservative, mild digestive properties, relieve colic and gas.

Chemical components Essential oils, fatty oils, moisture (8.39%), proteins (15.68%), carbs (36%), fiber (14.80%), ash (9.8%), and mineral components like calcium, potassium, magnesium, phosphorus, salt, vitamin A, and niacin were all

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present in *Anethum graveolens*. Among the 1–4% essential oil present in *Anethum graveolens* fruits, the primary ingredients are carvone (30–60%), limonene (33%), and α-phellandrene (20.61%). Other constituents include pinene, diterpene, dihydrocarvone, cineole, myrcene, paramyrcene, dillapiole, isomyristicin, myristicin, myristin, apiol, and dillapiol. *Anethum graveolens* essential oil also included furanocoumarin, 5-(4"-hydroxy-3"methyl-2"-butenyloxy)-6, 7-furocoumarin, oxypeucedanin, oxypeucedanin hydrate, and falcarindiol.The extract of *Anethum graveolens* L. has total phenol and total flavonoid levels of 105.2 mg of gallic acid equivalents/g and 58.2 mg of catechin equivalents/g of the dried extract.[9-11]

PHARMACOLOGICAL ACTIVITY

Anti-Oxidant Effect:

Antioxidant activity of *Anethum Graveolens* using lung (A-549), human breast (MCF-7), and cervical (HeLa) carcinoma cell lines using H2O2 scavenging, DPPH radical scavenging and ferrous reducing antioxidant assays. Antioxidant activity was found dose-dependent. The production of ROS also observed in treated cells.[12]

Anitimicrobial Activity:

Extracts from *Anethum graveolens* seeds and their essential oil contain antibacterial qualities that work against a range of microorganisms. Pseudomonas aeruginosa, Salmonella choleraesuis, S. typhimurium, Shigella flexneri, Salmonella typhii, Listeria monocytogenes, Escherichia coli, Yersinia enterocolitica, Staphylococcus aureus, Bacillus cereus, Enterococcus faecalis, and Mycobacterium were all susceptible to the antimicrobial activity of the essential oils and acetone extracts.*Anethum graveolens* seed extracts have been found to have anti-ulcer properties and moderate effectiveness against Helicobacter pylori. Seed extracts, both aqueous and organic, have strong antibacterial properties. The essential oils are effective against three fungi: Candida albicans, Penicillium islandicum, and Aspergillus flavus. D-limonene and Dcarvone show effective antifungal properties against Aspergillus niger, Saccharomyces cerevisiae, and Candida albicans.Many writers believe that furanocoumarin in *Anethum graveolens* is responsible for its antibacterial properties.[13-15]

Anti-inflammatory and Analgesic Activity:

The hydroalcoholic extract of *Anethum graveolens* seed significantly reduced inflammation and discomfort in rats.[16] Rats' paw volume was considerably reduced by *Anethum graveolens* oil and diclofenac gel ($p < 0.001$) when compared to the control group. *Anethum graveolens* oil significantly decreased paw volume compared to diclofenac.[17] Applying an ethanol extract of the fruits to the inner and outer surface of mice's ears reduced inflammation caused by 12-O-etradecanoylphorbol-13 acetate by 60%.[18] A 10% aqueous extract of the fruits and 5% aqueous solution of the essential oil effectively relieved pain in mice generated by hot plate and acetic acid writhing models. The fruits (1.0 g/kg body weight) had a similar impact as acetylsalicylic acid (200 mg/kg body weight).[19]

Antiparasitic Activity:

It was determined that *Anethum graveolens* has antiparasitic action against Entamoeba histolytica, which causes extraintestinal amebiasis. Complete mortility of E. histolytica was demonstrated by in vitro testing of plant extract at 12.5 mg/mL of concentration.In vivo screening also gave positive result. [20]

Hepatoprotective Activity:

The essential oil of *Anethum graveolens* has a hepatoprotective effect against carbon tetrachloride (CCL4), which causes hepatotoxicity in rats. The results demonstrated that the combination of fennel and dill oils might reduce the hepatotoxicity of CCL4 at a significant level of $p < 0.05$ and lower the amount of aspartate transaminas. [21]

Anti-Diabetic Activity:

Several clinical trials have examined the potential mechanisms of *Anethum graveolens* has strong antidiabetic action, including increasing fecal excretion, inhibiting intestinal cholesterol absorption, binding to bile acids in the intestine, and increasing bile acid production. By reducing acyl CoA carboxylase and 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase, major components of anethum, including limonene, A-phellandrene, and carvone, significantly contribute to the hypolipidemic effects and profoundly impact fatty acid absorption and cholesterol metabolism. [22]

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Diuretic Effects:

In a preliminary phytochemical screening, the seeds of *Eruca sativa* Mill., the fruits of *Anethum graveolens* L., *Apium graveolens* L., and *Daucus carota* L. were found to contain only glucosesinolates, while the other four plants were composed of flavonoids, sterols and/or triterpenes, carbohydrates and/or glycosides, and volatile oil. According to pharmacological assessments of the plants' diuretic activity, the ethanolic extracts of *Eruca sativa* seeds, the fruits of *Anethum graveolens* and *Daucus carota*, and the volatile oils in the former two plants have been shown to improve urine flow in dogs. While the volatile oil from *Anethum graveolens* seeds only considerably enhanced the excretion of Na+ and Cl−, the volatile oil from Eruca seeds significantly raised the excretion of Na+, K+, and Cl in urine.[23]

Anti-ulcer Activity:

Dill seed is used to treat some gastrointestinal conditions as a folk medicine. Dill seed extracts, both aqueous and ethanolic, had notable antisecretory and mucosal protective actions on the stomach mucosa in mice. Mice were given oral HCl (1 N) and 100% ethanol to cause gastric mucosal ulcers. Pylorus-ligated mice were used to evaluate the acidity and total acid content of their gastric juice. When the extracts were administered intraperitoneally or orally, the acidity and total acid concentration decreased.[24] Helicobacter pylori was moderately affected by dill seed extracts. Dill essential oil decreased rabbit intestinal spasms.[25] Acetylcholine and histamine-induced guinea-pig ileum contractions were reduced by ethanol extract. [26] The essential oil reduced foaming and exhibited a mild carminative action in vitro.[27]

Osteoporosis and Bone Health:

Dill's calcium content makes it a valuable component in preventing bone loss and the depletion of bone mineral density. Millions of people suffer from osteoporosis every year, and calcium and other vital minerals are required for healthy bone growth and development as well as bone repair. [28]

Benefits of Carminatives:

Dill, an established carminative, can help avoid the unsightly problem known as excessive gas. In addition to being difficult to deal with in public, the accumulation of gas can be harmful if it presses against the sensitive organs in the chest cavity. A carminative pushes gas through the digestive tract and enables it to safely exit the body.[29]

Anti-diarrheal Effect:

Indigestion and microbial activity are the two main causes of diarrhea. Due to its excellent digestive qualities, dill can be particularly beneficial when it comes to indigestion. Dill can be beneficial because its essential oils contain monoterpenes and flavonoids that have bactericidal or germicidal properties. By preventing microbial diseases from attacking the body, they can aid in the treatment of diarrhea.[30]

Hypolipidemic Effect:

The aerial components of *Anethum graveolens,* the dill herb, are used as a hypolipidemic drug in Iran. The scientific basis for its use is yet unknown. The hypolipidemic action of dill powder is tested by this study and its essential oil, which is its most important component, in male Wistar rats (180 +/- 20 g) fed a high-cholesterol diet. *Anethum graveolens* essential oil (AGEO) was produced by hydrodistillation and analyzed by GC/MS. According to GC/MS analysis, the primary components of *Anethum graveolens,* which had a 2% yield, were carvone (28%), limonene (28%), and alpha-phellandrene (32%). Rats received oral *Anethum graveolens* at doses of 45, 90, and 180 mg/kg each day for two weeks. Triglycerides, low density lipoprotein cholesterol (LDL-C), and total cholesterol were all significantly and dose-dependently reduced as a result.[31]

In addition to their potent antihyperlipidemic properties, the crude extracts of *A. graveolens* L. enhanced the biological antioxidant status of rats given a high-fat diet by lowering lipid peroxidation in the liver and regulating the activities of antioxidant enzymes.[32, 33] Compared to rats given only a high-fat diet, hyperlipidemic rats given a high-fat diet plus deffated ethanolic *Anethum graveolens* extract (a single daily dose of 1 ml, equivalent to 500 mg of the plant powder)

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showed a reversal of serum cholesterol levels for up to 10 and/or 30 days. Additionally, it caused a notable rise in the HMGCoA/mevalonate ratio in comparison to rats that were given a high-fat diet following a 30-day treatment with defatted ethanolic extract from *Anethum graveolens* L.[34] Rats exhibited hypolipidemic effects from dill powder and essential oils as well. [33] In dogs, iv injection of either 4.0 ul/kg body weight of the essential oil or 12.5 mg/kg body weight of 70% dry ethanol extract of the fruits dissolved in normal saline caused dieresis and improved excretion of calcium and salt.[35] Cats administered 5–10 mg/kg body weight of 5% seed oil in saline intravenously experienced hypotension and an increase in respiratory volume.[36,37]

II. CONCLUSION

The plant *Anethum graveolens* contains a variety of chemical components that have a wide range of pharmacological effects. There is a great promise for development of novel drugs from *Anethum graveolens* to treat human diseases as a result of its effectiveness and safety.

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