



A Review on Biological Activities of Dill Plant: Make Herbs A Habit

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Abstract:

Dill, or *Anethum graveolens* L., is a member of the Umbelliferae family and one of the most beneficial herbs and spices for producing essential oils. Dill is a therapeutic herb that is grown all over the world. Dill seeds are employed as a flavouring agent. The main components of essential oil, which may be isolated from different plant parts, are dill carvone, limonene, dill apiol, and -phellendrene. Promising antibacterial, antifungal, antioxidant, insecticidal, anti-inflammatory, antidiabetic, antispasmodic, hypolipidemic, and other actions are present in the dill plant's essential oil and extracts.

Keywords: Anethum Graveolens, Dill, Anti-fungal, Anti-diabetic, Gynaecological Effect

Introduction:

Due to side effects of synthetic drugs, experts are currently focusing on solutions for designed pharmaceuticals in the therapeutic setting. According to the World Health Organization (WHO), the usage of medicinal plants has been steadily spreading around the globe [1].

The Greek word "anethum" comes from the word aneeton, which meaning strongly scented. Numerous studies have shown that *A. graveolens* has a variety of bioactivities, including antimicrobial, anti-inflammatory, antidiabetic, anti-hypercholesteromic, and antispasmodic effects [2].

It is frequently used in ayurvedic medicine to treat gastrointestinal pain, colic, and to aid with digestion. The katu tikta rasa, usna virya, katu vipaka, laghu, tiksna, and snigdha gunas of dill are its ayurvedic properties. It treats "vata," "kapha," ulcers, stomach aches, eye conditions, and uterine pain. For topical use in treating rheumatic and other joint swellings, Charaka recommended a mixture of linseed, castor seeds, and shatapushpa (*A. graveolens*) crushed with milk. The herb *A. graveolens* have tonic, revitalising, and brain-boosting effects according to Kashyapa Samhita. In unani medicine, it is utilised for colic, digestive issues, and even for diarrhoea. [3] One of the oldest seed spices that have been grown since the beginning of time is dill. [4]

It is generally referred to as dill in English, Shatapushpa in Ayurveda, Soya in Unani, Sadakuppai in Siddha, Shatapushpi in Sanskrit, Sowa in Hindi, and soya in Punjabi. The production and usage of dill as a food and medicine go back a long way. The Middle East, Russia, Iran, Egypt, Thailand, China, USA, Canada, Hungary, Bulgaria, Turkey, and Uzbekistan are among the regions where it is abundantly grown. In India, the sowa plant, also known as Indian dill, is mostly grown in Punjab, Uttar Pradesh, Gujarat, Maharashtra, Assam, and West Bengal. [5]

Botanical Description of plant-

Synonym- Dill fruit, Anethum, European dill, Fructus anethi



Classification –

Kingdom-Plantae

Division-Magnoliophyta

Class-Magnoliopsida

Order-Apiales

Family-Apiaceae

Genus-Anethum

Species-Anethum graveolens

Cultivation and Collection

Dill prefers full sun, rich, well-drained soil that is loose. It can handle pH values between 5.3 and 7.8. It needs 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.[7]

Biological Activities of dill Plant:**1. Anti-Cancer Activity:**

Monoterpenes are chemo-preventive, and since they are stimulating in nature, they activate the secretion of an enzyme called glutathione-S-transferase (the radical glutathione is an effective antioxidant) which is very effective in neutralizing carcinogens. It is particularly effective at neutralizing cyano and benzoderivatives and free radicals, thereby protecting the body from cancer. The other antioxidants in the essential oils of dill also contribute to cancer prevention.

Al-Oqail and Farshori also reported the caspase-dependent effect of *A. graveolens*. [8]. It showed anticancer activity by increasing the activity of caspase-3 and caspase-9. Moreover, the antiproliferative activity was tested by Nehdia, et al. [9] on breast cancer cell lines.

Methanol extracts of dill showed anti-proliferative activity against tumor cell lines MK-1, HeLa and B16F10 [10]. The aqueous extracts of dill weed and seed exhibited mutagenicity to *Salmonella typhimurium*. The aqueous methanol extracts were fractionated by the mutation assay. Isorhamnetin 3-sulfate (persicarin) and quercetin 3-sulfate were characterized as the mutagenic principles. Carcinogenicity was not observed when the diets containing dill weed and seeds in 33% were administered to the inbred strain ACI rats [11]. Dill weed oil induced the detoxifying enzyme glutathione S-transferase in several mouse target tissues. A, β -unsaturated ketone system in carvone appeared to be critical for the high enzyme-inducing activity [12].

2. Anti-inflammatory And Analgesic Activity:

The hydro alcoholic extract of the *Anethum graveolens* seed caused significant decrease in the inflammation and pain in rats [13]. *Anethum graveolens* oil and diclofenac-gel showed a significant ($p < 0.001$) decrease in the paw volume in rats compared to the blank group. *Anethum graveolens* oil showed even more decrease in the paw volume compared to the diclofenac [14]. A single topical application of an ethanol extract of the fruits to the inner and outer surface of the ear of mice inhibited ear inflammation induced by 12-O- tetradecanoylphorbol- 13 acetate by 60% [15]. A 10% aqueous extract of the fruits and 5% aqueous solution of the essential oil had analgesic effects in mice pain induced by hot plate and acetic acid writhing models. The effect of the fruits (1.0 g/kg body weight) was comparable to 200 mg / Kg body weight of acetyl salicylic acid [16].

3. Anti-Fungal Activity:

Dill seed essential oil was tested for antifungal activity against *A. flavus*, *A. oryzae*, *A. niger* and *Alternaria alternata* (in vitro) by poisoned food technique. The minimum inhibitory concentration of dill seed oil against four tested fungi was found to be 2.0 ml/ml. Observations on the microstructure of *A. niger* showed degenerative alterations in the conidial heads and hyphal morphology after oil treatment that included distorted conidial heads, decreased hyphal diameters, shrivelled hyphal aggregates and swelling of the hyphal wall [17].

Antifungal activity of dill seed essential oil was also evaluated against seven fungal pathogens (*A. niger*, *A. flavus*, *Ochraceus*, *Penicillium expansum*, *F. oxysporum* f. sp. *Albedinis*, *A. alternata* and *Cladosporium* species) by measuring minimum inhibitory concentrations according to the direct contact method and evaluating inhibition of germination and sporulation of spores. The results of direct contact method for mycelia growth showed that all strains were inhibited at MIC 1/500 v/v, except *A. niger* at MIC 1/180 v/v. *A. alternata* was most sensitive, with inhibition at MIC as weak as 1/6500 v/v. However, concentration of 1/370 v/v completely inhibited the mycelia growth of all tested strains, except *A. niger* at 1/150 v/v. Dill seed essential oil

also showed prompted antifungal activity against germination and sporulation of spores. All fungal strains were inhibited at concentrations as weak as 1/370 v/v. *F. oxysporum* f. sp. *albedinis*, *A. flavus* and *A. alternata* were most sensitive, being inhibited as from 1/1500 v/v [18].

4. Anti-Ulcer Activity:

As a folk remedy, dill seed is used for some gastrointestinal ailments. Aqueous and ethanolic extracts of dill seed showed significant mucosal protective and antisecretory effects of the gastric mucosa in mice. Gastric mucosal lesions were induced by oral administration of HCl (1 N) and absolute ethanol in mice. The acidity and total acid content of gastric juice were measured in pylorus-ligated mice. The acidity and total acid content were reduced by the orally or intraperitoneally administration of the extracts [19]. Dill seed extracts exerted moderate activity against *helicobacter pylori*. The essential oil of dill reduced contractions of rabbit intestine [20]. Ethanol extract inhibited acetylcholine and histamine induced contractions of guinea-pig ileum [21]. The essential oil was a mild carminative and reduced foaming in vitro [22].

5. Anti Hypercholesterolaemic Effect:

Hyperlipidemia is highly prevalent disorder, a major cause of atherosclerosis which leads to ischemic heart disease [23]. The effect of dill extract on serum lipoproteins (changes in serum triglyceride (TG), total Cholesterol (TC), high density lipoprotein-cholesterol (HDL-C) and low density lipoprotein-cholesterol (LDL-C) in hypercholesterolaemic rats was studied and its mechanism of action to some extent on liver hydroxy-3-methyl-glutaryl CoA (HMG-CoA) reductase activity was also studied. Administration of dill extract to hyperlipidaemic rats significantly lowered serum TG (33.1%), TC (38.5%) and LDL-C (66.5%) levels and increased HDL-C level (24.6%). The rats treated with dill extract showed further decrease in The HMG-CoA reductase activity [24].

Serum triacylglycerides and total cholesterol levels in rats, with hyperlipidaemia induced by diet, were determined after oral administration of a water extract of dill leaves before and after the extraction of the furocoumarin content of the leaves. Administration of the extracts consecutively for 14 days reduced the triacylglycerides and total cholesterol levels by almost 50 and 20%, respectively. Chloroform extraction of furocoumarins from the aqueous extracts did not reduce the antihyperlipidaemic potential of the extracts to a significant degree. Oral administration of the essential oil of dill seeds, at two different doses, also reduced the triacylglyceride levels by almost 42%. The total cholesterol level was not reduced by the same doses of the essential oil [25].

6. Hypolipidemic Effect:

The aerial parts of *Anethum graveolens* (dill weed) are used in Iran as a hypolipidemic agent. The scientific basis for its use has yet to be established. In this study the hypolipidemic Activity of dill powder and its essential oil (its most important fraction) were evaluated in male Wistar rats (180 +/- 20 g) fed a high cholesterol diet. *Anethum graveolens* essential oil (AGEO) was prepared by hydrodistillation and analyzed using GC/MS. AGEO had a yield of 2% and GC/MS analysis showed that alpha-phellandrene (32%), limonene (28%) and carvone (28%) were its major components. Daily oral administration of AGEO to rats at doses of 45, 90 and 180 mg/kg for 2 weeks significantly and in a dose-dependent manner reduced total cholesterol, triglyceride and low density lipoprotein cholesterol (LDL-C). AGEO also increased significantly high density lipoprotein cholesterol (HDL-C). *Anethum graveolens* powder when added to the diet of animals showed similar effects on serum lipids. It is concluded that *Anethum graveolens* has significant lipid lowering effects and is a promising cardio protective agent [26].

7. Hyperlipidemic Effect:

The crude extract of *Anethum graveolens* L showed anti hypercholesterolaemic and anti-hyperlipidaemic activities. The crude extracts of *A. graveolens* L. besides having strong antihyperlipidaemic effects, it improved the biological antioxidant status by reducing lipid peroxidation in liver and modulating the activities of antioxidant enzymes in rats fed with high fat [27-29]. Treatment of hyperlipidaemic rats with defatted ethanolic *Anethum graveolens* L. extract (single daily dose of 1 ml, equivalent to 500 mg of the plant Powder) and high-fat diet for up to 10 and/or 30 days reversed the serum lipid levels compared to rats which were fed only high-fat diet. In addition, it induced significant increase in HMGCoA/mevalonate ratio as compared to rats which were fed high-fat diet after treatment with defatted ethanolic *Anethum graveolens* L. extract for 30 days [30]. Dill powder and its essential oils also exerted hypolipidaemic activity in rats [31]. Intravenous administration of 12.5 mg/kg body weight of 70% dried ethanol extract of the fruits dissolved in normal saline or 4.0 µl/kg body weight of the essential oil induced diuresis and enhance sodium and ca xcretion in dogs [32]. Intravenous administration of 5–10 Mg/kg body weight of 5% seed oil in saline to cats caused hypotension and increased respiration volume [33-35].

8. Anti-Oxidant Effect:

Antioxidant activity of *A. 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 [36].

9. Anti-Diabetic Activity:

It's been investigated by several clinical trials that anethum has significant antidiabetic activity by evaluating possible mechanisms like binding to bile acids in the intestine, increase in fecal excretion, inhibition of intestinal cholesterol absorption, and increased production of bile acids. Major components such as limonene, A-phellandrene and carvone of Anethum significantly participate in the hypolipidemic effects, via. 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase, reducing acyl CoA carboxylase and hence Significantly affecting the cholesterol metabolism and fatty acid Absorption [37].

10. Anti-spasmodic Effects:

Dill fruit was reported as potent antispasmodic agent. Contraction induced by a variety of spasmogen in rat ileum Was significantly relaxed by alcoholic extract of dill fruit. The Precontracted ileum of male wistar rats by potassium chloride (60 mm), acetyl choline esterase (1 μ m) and barium chloride (4mm) were relaxed by the cumulative concentration of dill Fruit hydro alcoholic extract (0.5-4.0 mg/ml). The relaxatory Effect of the extract on the barium chloride -induced ileum Contractions was greater than the other spasmogens. Results Indicated that the α -and β -adrenoceptors, opioid receptors and NO generation were not involved in inhibitory effect of Alcoholic extract of dill fruit. However, the relaxatory effect Of dill fruit hydroalcoholic extract on the ileum may be due to Blockage of voltage dependent calcium channels [38].

11. Diuretic Effects:

A preliminary phytochemical screening of fruits of Anethum graveolens L., Apium Graveolens L., Daucus carota L., and seeds of Eruca sativa Mill., revealed the presence of volatile oil, sterols and/or triterpenes, carbohydrates and/or glycosides, tannins and flavonoids in the four entitled plants; Glucosinolates were detected only in Eruca seeds. Pharmacological Evaluation of the aforementioned plants for diuretic activity has shown the ethanolic extracts Of Eruca sativa seeds and fruits of Anethum graveolens, Daucus carota as well as the volatile Oils in the former two plants to produce an increase in urine flow in dogs. Volatile oil of Eruca seeds, significantly, increased Na⁺, K⁺ and Cl⁻ excretion in urine, whereas Anethum graveolens volatile oil significantly increased Na⁺ and Cl⁻ excretion only [39].

12. Insecticidal Activity:

Chaubey evaluated the insecticidal activity of A. graveolens. The activity was assessed using the fumigation method. The lethal Concentrations (LC50) were obtained as follows 0.316 and 0.243 μ L.cm⁻³ air; A. graveolens. The reduction in progeny production was also observed after treatment[40].

13. Anti-Bacterial Activity:

Anethum graveolens Linn, Foeniculum vulgare Mill. And Trachyspermum ammi L. are widely used traditional medicinal plants to treat various ailments. To provide a scientific basis to traditional uses of these plants, their aqueous and organic seed extracts, as well as isolated phytoconstituents were evaluated for their antibacterial potential. Antibacterial activity of aqueous and organic seed extracts was assessed using agar diffusion assay, minimum inhibitory concentration and viable cell count studies; and their antibacterial effect was compared with some standard antibiotics. The presence of major phytoconstituents was detected qualitatively and quantitatively. The isolated phytoconstituents were subjected to disc diffusion assay to ascertain their antibacterial effect. Hot water and acetone seed extracts showed considerably good antibacterial activity against all the bacteria except Klebsiella pneumoniae and one strain of Pseudomonas aeruginosa. Minimum inhibitory concentration for aqueous and acetone seed extracts ranged from 20–80 mg/ml and 5–15 mg/ml respectively. Viable cell count studies revealed the bactericidal nature of the seed extracts. Statistical analysis proved the better/equal efficacy of some of these seed extracts as compared to standard antibiotics. Phytochemical analysis showed the presence of 2.80 – 4.23% alkaloids, 8.58 – 15.06% flavonoids, 19.71 – 27.77% tannins, 0.55–0.70% saponins and cardiac glycosides. Antibacterial efficacy shown by these plants provides a scientific basis and thus, validates their traditional uses as homemade remedies. Isolation and purification of different phytochemicals may further yield significant antibacterial agents [41].

14. Anti-microbial Activity:

The essential oil and different extracts of Anethum graveolens seeds exerted antimicrobial activity against wide range of microorganisms. The essential oils and acetone extracts shown antimicrobial activity against Staphylococcus aureus, Bacillus cereus, Enterococcus faecalis, Listeria monocytogenes, Escherichia coli, Yersinia enterocolitica, Salmonella choleraesuis, S. typhimurium, Shigella flexneri, Salmonella typhi, Pseudomonas aeruginosa, and Mycobacterium. Anethum graveolens seed extracts have also been reported to possess anti-ulcer activity, and have shown moderate activity against Helicobacter pylori. Aqueous and organic extracts of seeds have exhibited potent antibacterial activity. The essential oils also active against three fungi (a yeast, Candida albicans and two molds, penicillium islandicum and Aspergillus flavus). D-limonene and D-carvone, have exhibited strong antifungal activity against Aspergillus niger, Saccharomyces cerevisiae and Candida albicans. Many authors mentioned that the antimicrobial activities could be attributed to furanocoumarin in Anethum graveolens [42].

15. Gynaecological disorders:

The major biological properties and gynaecological uses of includes:

a. Postpartum hemorrhage-

Atonic uterus is the most common cause of Post partum haemorrhage. Researchers have proved that Dill seed extract is useful for the contraction of uterus. A dose of 6-7 gm of dill seed extract after delivery decreases postpartum haemorrhage due to its contractive characteristic. Limonene and anethum showed contractive effect on uterine myometrium. Ishikawa and mahdavian . also found that aqueous extract of Dill fruit decreases postpartum haemorrhage through increasing the uterus contractions [43].

b. Dysmenorrhoea-

Dysmenorrhoea literally means painful menstruation. It is one of the most common gynaecological problems. Primary dysmenorrhoea is one where there is no identifiable pelvic pathology. Incidence of primary dysmenorrhoea of sufficient magnitude with incapacitation is about 5-10% [44]. In double-blind randomized study by Reza et al., it was demonstrated that Dill can be as effective as mefenamic acid in decreasing the pain severity of primary dysmenorrhoea. [45]

c. Labour pains-

Anethum graveolens seed affect the pattern of uterine contraction and shorten the fall time although feedback mechanism is not known. Dill seed consumption, due its contents and combination such as limonene and tannin increases the contraction of uterus and causes better progress of delivery process. Dill seed consumption shortens the first stage of labour. Dill seed can be used for augmentation of uterine contraction in low risk women in labour and also prevention of post term pregnancy.

d. Galactagogue

Adequate breast feeding is must for normal physiological growth of baby especially up to the first six month of life. Sometimes if there is inadequate production of milk, growth of baby is likely to be affected. has capacity to increase the production of milk and researchers, literature have proven it. So it can be used as Galectagogue [46].

e. Postmenopausal female-

Postmenopausal women are at a risk of developing diseases like osteoporosis, cardiovascular diseases and cancer along with their mortality rate and burden of their management and side effects have turned attention of all medical sciences to a safe, cheap and effective alternative. Phytoestrogens are now being thought beneficial in such patient and gaining popularity [47]. Contains Beta Sitosterol and can be used as a source of phytoestrogen. Phytoestrogens bind to oestrogen receptors just as oestrogen, but they have more affinity for oestrogen receptor β found in brain, bone, bladder and vascular epithelia. In breast and endometrial tissue, phytoestrogens acts as anti estrogenic. So when used in proper way these can be beneficial in breast CA, Endometrial CA, and also in the management of menopause. These are also useful in reducing the menopausal sign and symptoms like hot flush, vaginitis, anxiety and osteoporosis [48].

f. Infertility-

Use of oil for Nasya, abyanga and is beneficial in female infertility. Oral intake Of and oil also found useful in infertile female [49].

16. Adaptogenic Activity:

Anethum graveolens Linn. (Umbelliferae, A. graveolens) is a widely used spice with a long history of traditional medicinal use for the treatment of various ailments. The present study examines the anti-stress and cognition-improving effects of A. graveolens extract in a rat model. Urinary vanillylmandelic acid (VMA) and ascorbic acid were estimated as biomarkers For evaluating antistress activity in rats. Conditioned avoidance response using Cook's pole climbing apparatus in normal and scopolamine-induced amnesic rats was used to assess cognitive-improving activities. Thiobarbituric acid reactive substances (TBARS) assay was used to evaluate antioxidant activity. Daily administration of A. graveolens at doses of 100, 200 and 300 mg/kg body weight 1 h prior to induction of stress inhibited stress-induced urinary Biochemical changes in a dose-dependent manner without altering the levels in normal control groups. Changes in cognition (as determined by the acquisition), retention and recovery in rats were dose-dependent. The extract also produced significant lipid peroxidation inhibition in both rat liver and brain, compared to a reference standard antioxidant, ascorbic acid. The aqueous extract of A. graveolens exhibited significant anti-stress, antioxidant and memory enhancing activities. The study provides a scientific basis for the traditional use of the plant as a culinary spice in foods [50].

17. Genotoxic Effect:

Genotoxic effect of the essential oils extracted from dill herb and seeds were studied using chromosome aberration (CA) and sister chromatid exchange (SCE) tests in human lymphocytes in vitro, and *Drosophila melanogaster* somatic mutation and recombination test (SMART) in vivo. The highest concentration tested (0.25ml/ml) induced a 16-fold (dill herb) and 19-fold (dill seeds) increase over control. Essential oil from dill seeds was slightly more clastogenic than essential oil from dill herb. Also in SCE test essential oil from dill seeds seems to be slightly more active than essential oil from dill herb, whereas essential oil from dill herb was very active in inducing somatic mutations in *D. melanogaster* than from essential oil from dill seeds[51].

18. Osteoporosis and bone health:

The calcium content of dill means that it is an important element in protecting you from bone loss and the loss of bone mineral density. Osteoporosis affects millions of people each year, and calcium, along with other essential minerals, is a key component in the proper growth and development of bones and the repair of injured bones as well[52].

19. Carminative benefits:

As a well-known carminative, dill can help prevent the embarrassing condition of excessive gas. It is not only an uncomfortable condition to experience in public, but if gas continues to build up, it can actually be a dangerous situation where it presses on the delicate organs of the chest cavity. A carminative force gas downward through the digestive tract and allows it to leave the body in a safe way[53].

20. Anti-diarrheal Effect:

Diarrhea is mainly caused by two things; indigestion and microbial action. In terms of indigestion, dill can be quite helpful, as it has very good digestive properties. Secondly, dill can help due to the monoterpenes and flavonoids present in its essential oils, which are germicidal or bactericidal in nature. They can help cure diarrhea by inhibiting microbial infections that try to attack the body[54].

21. Hepatoprotective activity

The hepatoprotective effect of *A. graveolens* essential oil against carbon tetrachloride (CCL₄) which is responsible for hepatotoxicity in rats. The result showed the mixture of dill oil with fennel oil has the capacity to inhibit hepatotoxicity of CCL₄ at $p < 0.05$ of significance level also decreased the level of aspartate transaminase (AST) and alanine transaminase (ALT) in blood serum[55].

22. Preventive cure for insomnia

The essential oils found in herbs have peculiar and powerful properties. They act as a stimulative, sedative and hypnotic. They stimulate as well as pacify. Similarly the essential oils from dill seeds are no exception. The flavonoids and vitamin-B complex present in its essential oils, activate the secretion of certain enzymes and hormones which have calming and hypnotic effects, thereby helping people get a good night's sleep[56].

Conclusion:

Dill is widely cultivated under large areas in India. Both the cultivable species as illustrated above bear immense inherent medicinal and therapeutical values. This has been used for the treatment of various common ailments successfully without any side effects. Various plant parts and their extracts have been found to cure or provide relief in today's health issues. The common cures explored are antimicrobial activity, indigestion, vomiting, antidiarrheal, galactagogue, antispasmodic, menstrual pain, blood pressure etc. The specific cures of dill seed extract include insomnia, cancer, diabetes, hypertension, bone density and immunity maintenance etc. The data can be validated from the presence of various bioactive compounds present in significant quantity having the proven potentiality to cure and heal the various ailments. There is a great promise for development of novel drugs from *A. graveolens* to treat various diseases as a result of its effectiveness and safety.

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