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Review

Unveiling the Medicinal Potential of *Artemisia pallens*: A Review of its Pharmacognostical, Phytochemical, and Pharmacological Properties

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Abstract

Davana, also known as *Artemisia pallens* Walls, ex DC, is a fragrant herb that grows widely 0ver India's plains in humid environment. Tribal people have utilized *Artemisia pallens*, which grows in the Nilgiris hills, to treat a variety of illness. India traditional medicine has made extensive use of it treat diabetes mellitus. This plant is regarded as a good feed and has anthelmintic, antipyretic, tonic qualities. The oil has antibacterial and antifungal, antispasmodic and stimulating qualities. The plant's antibacterial, antidiabetic antinociceptive and wound-healing properties have all been examined. The phytochemistry and pharmacology of *Artemisia pallens* are the subjects of the current investigations. In order to help researchers, reach their future objectives of approaching its industrial or commercial viability as a natural product ingredient, the review focus on the full range of ethnomedical uses, phytochemical properties namely its volatile and non-volatile constituents, and pharmacological properties.

Keywords: *Artemisia pallens*, ethnomedical uses, microscopical observations, phytochemical properties, pharmacological studies.

1. INTRODUCTION

In Ayurveda, *Artemisia pallens*, also referred as "Davana" is a multipurpose medicinal plant that can be used either alone on conjunction with other medicinal plants to treat a range of condition with other medicinal plants, including antidiabetic properties. The shrub plant *Artemisia pallens*, which belongs to the opposite family, is primarily found in Mysore city. Davana is primarily grown in southern India's red soil regions, such as Tamil Nadu and Karnataka. Numerous pharmacological properties of *Artemisia pallens* have been documented,

including its ability to act as a antifungal, antibacterial and perfumes. India is a major exporter of *Artemisia pallens* oil to the rest of the globe, and it is one of the most important aromatic plants used in the cosmetic and perfumery industries. Davana is frequently used to treat diabetes mellitus in India and Iraqi traditional medicine[1].

The bitter aromatic genus *Artemisia* (Asteraceae) is sometimes referred to as "Worm wood" or "Sage brush". *Artemisia* is the largest genus with 400 species spread across South America and South Africa, including 34 in India. The Greek goddess of virginity, Artemis, is honoured by the name of species. Nearly every species is known to contain sesquiterpene lactones[2].

Davana produces small flowers, recombination breeding is a laborious way to create variety. Consequently, it is preferable to use mutant breeding to produce variety in Davana. The goal of the current study was to describe the different morphological and biochemical mutants that were separated from the M2 and M3 genera that were cultivated from gamma rays and seeds treated with EMS[3].

The World Health Organization defines medicinal plants as those whose organs contain components that may be utilized therapeutically or as a starting point for the synthesis of powerful medications. In ancient times, people have employed plants for healing, which is the bedrock of many present-day medication[4].

Taxonomical classification

Kingdom	:	Plantae
Division	:	Angiosperm
Class	:	Eudicots
Order	:	Asterales
Family	:	Asteraceae
Genus	:	Artemisia
Species	:	pallens
Binomial name	:	Artemisia pallens[2].

4. Synonyms

Artemisia absinthia B Heyne ex Hook.f.
Artemisia orientalis Herb.Madr. ex DC
Artemisia paniculata Roxb[5].

5.Common names

Artemisia pallens, commonly known as Davana, has different names across various languages,

Tamil	:	Davanam, Marikozhunthu
English	:	Wormwood
Hindi	:	Davana
Kannada	:	Davana and Manji pathre
Telugu	:	Davanamu
Malayalam	:	Davanam
Sanskrit	:	Davanam
Marathi	:	Devna
Gujarati	:	Damoro
Bengali	:	Dona [6].

6.Geographical distribution:

In the temperate Himalayas, the plant grows naturally. It is prevalent in the Shimla, Nanital, and Kashmir Valley. On an area of roughly 1000 hectares, it is grown commercially in Karnataka, Maharashtra, Kerala, Tamil Nadu, and Andhra Pradesh. There are roughly 280 species in the genus *Artemisia,* and they are primarily found in temperate climates (Rao et al., 1978). There are more than 30 species of *Artemisia* in India, most of which are found in the Himalayan belt, however some also grow in tropical and subtropical regions (Bakshi and Kaul, 1984). There have been unsuccessful attempts to grow this crop in the agroclimatic conditions of North India (Gulathi, 1980). In terms of both acreage and davana output, Karnataka leads, with Bangalore accounting for the majority of the state.[7] The plant's environmental is similar to that of Mysore's sandalwood trees. It is a fragrant herb that grows widely over India's plains in humid environment[6].

7.Ethnomedicinal uses

In Indian traditional medicine, *Artemisia pallens*, also referred to as "Davana", has long been used to treat diabetes mellitus, wound healing, immunomodulation, antihelmintic, antipyretic, antibacterial, antifungal, tonic and stimulant properties (Druery and Wallington, 1980). It is regarded as good fodder as well. The oil has stimulant, antibacterial, antifungal, antispasmodic qualities.

Oil of Davan is an essential oil that is produced from the leaves and flowers. Some species provide the vital antihelmintic medication santonin, while others produce essential oil and are used as fodder. Davana has been used extensively to treat diabetes mellitus in India and Iraqi medicine. In rats and mice treated with alloxan and glucose-fed hyperglycemia, oral administration of an aqueous/methanolic extract from the plant's aerial portion was found to be lower diabetes[2].

Davana oil helps you to reduce anxiety since it relaxing and emotionally balanced. Davana oil is utilized to create perfumes with fruity and pleasant scents. Davana is claimed to smell different on different people when applied topically. In high-end perfumery, this distinctive quality is highly priced foe reducing scents with genuinely unique overtones. Davana oil relieves cuts, infections, rough, dry, chapped skin[9].

In Indian traditional medicine, *Artemisia pallens* has been used extensively to treat diabetes mellitus. This herb is known to have tonic, antipyretic, and antihelmintic qualities. It is regarded as good fodder as well. The oil has stimulant, antibacterial, antifungal, and antispasmodic qualities[8].

8. Numerical taxonomy

The *Artemisia* genus, from the family Asteraceae, includes about 500 species most commonly found widespread species of flowering plant native to Indian subcontinent. Among those 6 different species are found in India.

The following six different species of ***Artemisia*** was selected for numerical taxonomy

- *Artemisia pallens*
- *Artemisia annua*
- *Artemisia vulgaris*
- *Artemisia absinthium*
- *Artemisia tridentata*
- *Artemisia abrotanum*

Parameters	***Artemisia pallens***	***Artemisia annua***	***Artemisia vulgaris***	***Artemisia absinthium***	***Artemisia tridentata***	***Artemisia abrotanum***
Leaf arrangement	Alternate	Alternate	Alternate	Alternate	Alternately along the stem	Alternately along the stem
Leaflet margin	Lobed	Lobed	Lobed, Serrate	Small lobed, Serrated	Typically toothed or lobed at tip	Finely toothed
Leaflet venation	Pinnate	Pinnate	Pinnate	Pinnate	Pinnate	Pinnatifid segment
Leaflet shape	Small, narrow segments	Elliptical and lanceolate	Elliptical and oblong	Broadly ovate	Cuneate (narrowly triangular)	Small, narrow, feathery
Leaflet size	2-6mm(long) and 1-2 mm wide	3.1cm(long) and2.2cm (wide)	6.2cm(long)and 3.1cm(wide)	1-3 inches(long) and 0.5 -1.5 inches(wide)	1-3cm(long) and 0.3-1cm(wide)	1-3 inches(long) and less than 1 inch(wide)
Leaflet apex	Acute	3-Toothed	4-Toothed	Obtuse (rounded) or blunt	Typically 3-lobed	Acute
Leaf base	Attenuate or cuneate	Wide oliveform	Wide olivaeform	Typically cuneate/narrow	Typically cuneate	Cuneate
Petiole	The petiole boat shaped in cross-section with a distinct concave upper surface and a convex lower surface	The stalks that attaches the leaf blade to stem	Typically described as concave	Varies in length depends on the leaf position on the stem	Absent	Short, some sessile or sub-sessile

Leaf texture	Silky soft and velvety	Smooth	Smooth	Hairy and fine with a velvety feel	Hairy texture	Soft, downy and slightly fuzzy
Colour	Pale green and greyish green	Green-yellowish	Some white colour	Silvery green	Silvery grey or blue green	Grey-green
Odour	Fresh fruity and somewhat balsamic	Distinct, strong and aromatic	Sweet, strong, aromatic	Bitter, herbaceous, camphor- like	Strong, pungent	Strong, lemony and camphor-like scent

8.1 Chart of similarity

Parameters	***Artemisia pallens***	***Artemisia annua***	***Artemisia vulgaris***	***Artemisia absinthium***	***Artemisia tridentata***	***Artemisia abrotanum***
Leaf arrangement	1	1	1	1	0	0
Leaflet margin	1	0	0	0	0	0
Leaflet venation	1	1	1	1	0	0
Leaflet shape	1	0	0	0	0	0
Leaflet size	1	0	0	0	0	0
Leaflet apex	1	0	0	0	0	0
Leaf base	1	1	1	0	0	0
Petiole	1	0	0	0	0	0
Leaf texture	1	1	1	0	0	0
Colour	1	0	0	0	0	0
Odor	1	0	0	0	0	0

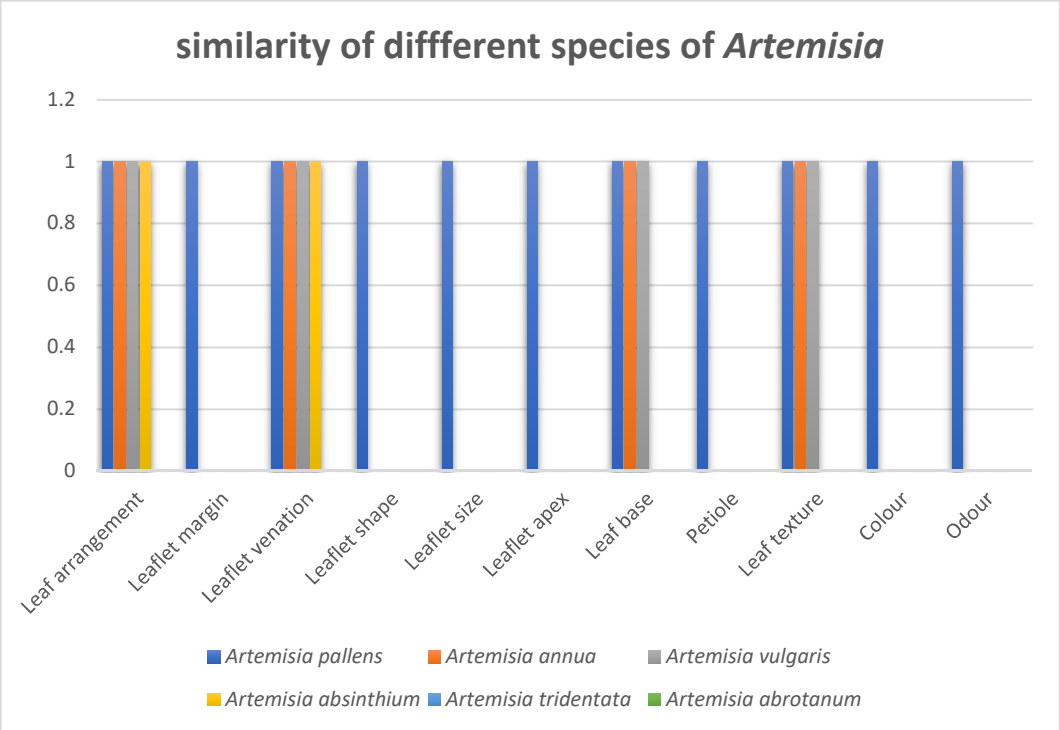

Fig 1: Chart of Similarity of Different Species of *Artemisia*

8.2 Chart of dissimilarity of different species of *Artemisia*

Species	*Artemisia pallens*	*Artemisia annua*	*Artemisia vulgaris*	*Artemisia absinthium*	*Artemisia tridentata*	*Artemisia abrotanum*
Artemisia allens	1	0.3	0.2	0.2	0	0
Artemisia annua	0.3	1	0.2	0.2	0	0
Artemisia vulgaris	0.2	0.36	1	0.18	0	0
Artemisia absinthium	0.2	0.36	0.36	1	0	0
Artemisia tridentata	0	0	0	0	1	0
Artemisia abrotanum	0	0	0	0	0	1

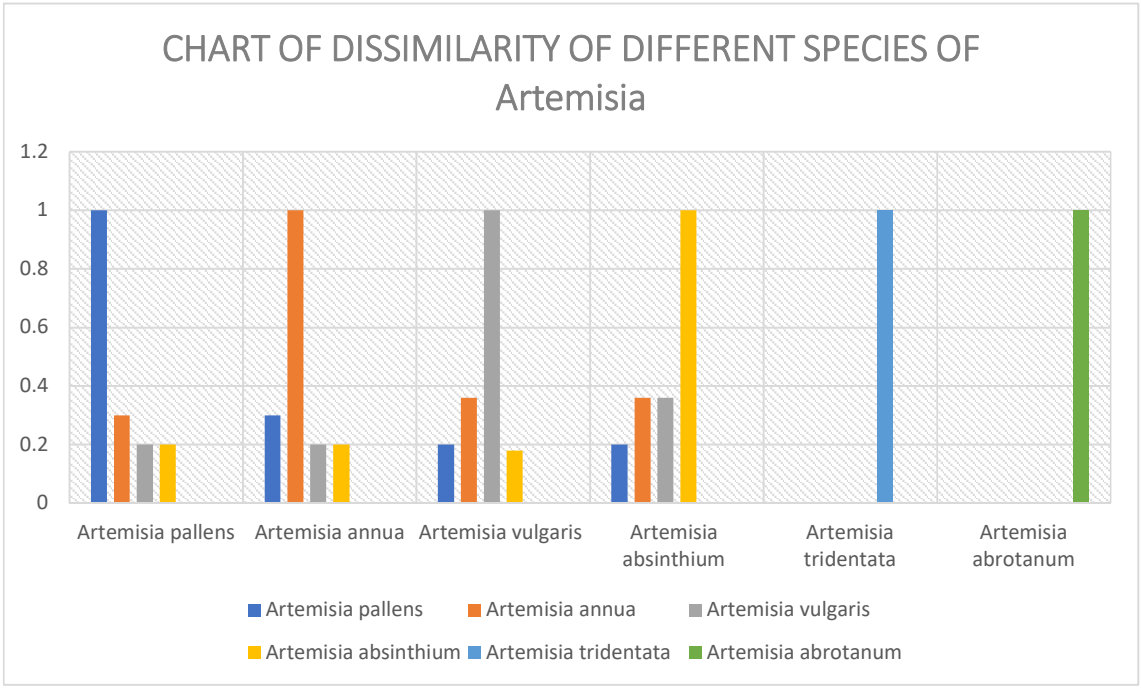

Fig 2: Chart of Didimilarity of Different Species of *Artemisia*

Sample matching coefficient
SSM = NS/NS+ND*100
Where,
NS= Number of similar characters – 21
ND = Number of Dissimilar characters – 45
N = Number of samples - 6
SSM of AP = 31.81%The matching coefficient of *Artemisia pallens* with respect to the other species was found to be

9. Morphological characterization

S.No	PARTS	PLANT REGION	MORPHOLOGICAL CHARACTERS
1	Stem		Erect, cylindrical, herbaceous, pubes green tuning light brown
2	Leaves		Alternate, finely divided (bi or tri-pinnatiscet) filiform segments, silvery green, aromatic
3	Flower		Disc florets (tubular bisexual); ray florets absent or rudimentary, pale yellow to yellowish - green

10.Pharmacgnostical review
Microscopical observation

10.1 Anatomy of leaf

The leaf has isolateral mesophyll tissue and is dorsiventral. The leaf surface is uniformly smooth. When viewed in cross section, the midrib is fairly noticeable and spindle-shaped, protruding equally on the top and bottom sides. The lower side of the midrib has a little furrow. The midrib is thin, unique epidermal layer has smooth cuticle and squarish cell. Compacted parenchymatous tissue envelops a single, sizable vascular bundle, which is collateral with parallel adaxial rows of xylem and abaxial rows of phloem. Both the upper and bottom sides of the vascular bundle include thick masses of sclerenchyma cells. The thickness of the midrib is 550 mu thick.

10.2 Lamina

The upper and lower surface of the lamina are even. Its border is broad and semi-circular(Figure 4). The thickness of the lamina is 350mu meter. The spindle-shaped, rather thick-walled cells make up the thin epidermal layers. Both the upper and lower sides of the epidermis are stomatiferous. A middle horizontal layer of two or three rows of the cells makes up the mesophyll. Palisade cells with broad, thin walls are seen on the upper and lower sides of the centre row(Figure 4). The median portion of the lamina contains the lateral veins vascular bundles. As one approaches the edge, the bundles get smaller. They have abaxial phloem and an adaxial xylem clusters as collaterals.

10.3 Venation

There are fewer, thinner lateral veins that produce less pronounced vein-islets. The islet is recognizable, broad, and irregularly shaped. There are occasional vein terminations, which are narrow, short and basic(Figure 5).

10.4 Trichomes

There are many normal epidermal trichomes on the leaf's surface. Trichomes come in two varieties, both of which are glandular in origin. With two terminal cells arranged end to end to form a spindle shape, this type of trichome has a short unicellular stalk(Figure 6). The spindle-shaped trichomes, which measures 50*30 mu meter, are dispersed evenly cross the lamina(Figure 6). These trichomes are not as prevalent. The trichomes is a slender, unicellular stalk that contains eight or more triangular cells arranged in a circular, thin plate. The nuclei of the cells are noticeable. The distribution of the orbicular trichomes is unpredictable. Their diameter is 35 mu meters(Figure 6).

10.5 Petiole

In cross section, the leaf's petiole has boat shaped, with a broad, shallow concavity on the adaxial side and a wavy, convex side. The squarish, thickly cuticle epidermal cells make up the conspicuous, stomatiferous epidermis. The ground tissue is made up of narrow bands of palisade tissue on both the adaxial and abaxial planes and a central horizontal band of compact parenchyma tissue. These consist of three or more tiny, less noticeable vascular strands on the either sides of the central strands, as well as the larger median vascular bundle.

10.6 Stem

The stem has primary vascular tissue and is youthful. Dense trichomes are seen on the stem surface. The thin, unique epidermis is made of tiny, squarish cells with a thick layer of cuticle. The cortex has tiny air pockets and is parenchymatous and homogenous. A number of distinct vascular bundles are placed in an elliptical circle on the stele. There are parallel rows of xylem elements in the collateral; vascular bundle. Figure 8 shows the broad bulk of phloem. A core elliptic chamber with broad parenchymatous boundaries make up the pith(Figure 8).

Artemisia pallens leaves are dorsiventral with isolateral mesophyll tissue, according to microscopical observation. When viewed in cross-section, the midrib is fairly noticeable, spindle-shaped, and equally projected on the top and bottom sides. The midrib's thin, unique epidermal layer has smooth cuticle and squarish cells.

Compacted parenchymatous tissue envelops a single, sizable vascular bundles, which is collateral with parallel adaxial rows of xylem and phloem. Both the upper and bottom sides of the vascular bundle include thick masses of the sclerenchyma cells. Both the upper and bottom surface of the epidermis are stomatiferous[2].

FIG. 3: SPECIES OF *ARTEMISIA PALLENS*

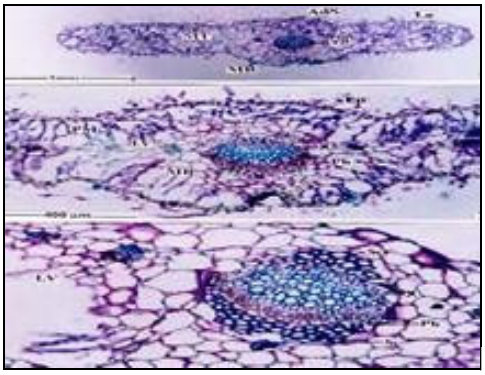

FIG. 4: ANATOMY OF THE LEAF

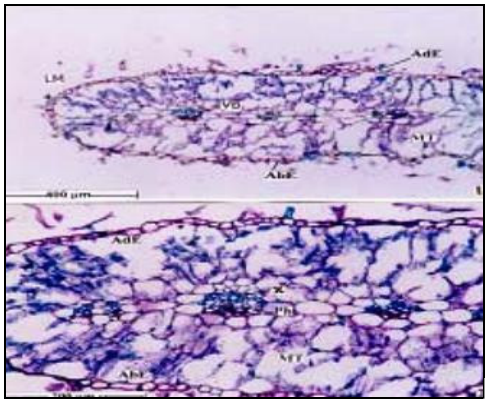

Fig 5: Anatomy of Lateral Vein With Leaf Margin

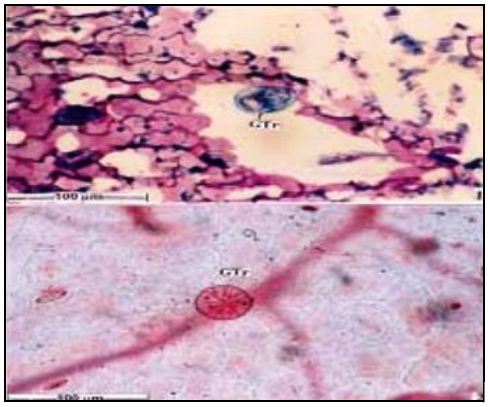

FIG. 6: TRICHOME MORPHOLOGY IN SURFACE VIEW

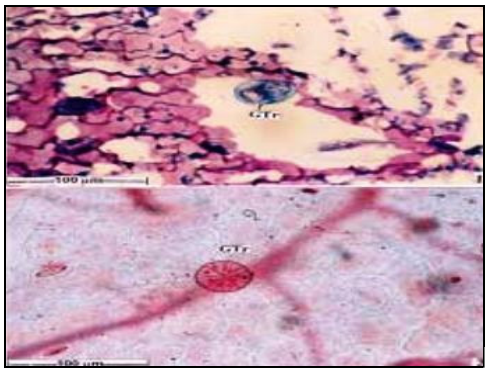

FIG. 7: STRUCTURE OF TRICHOME

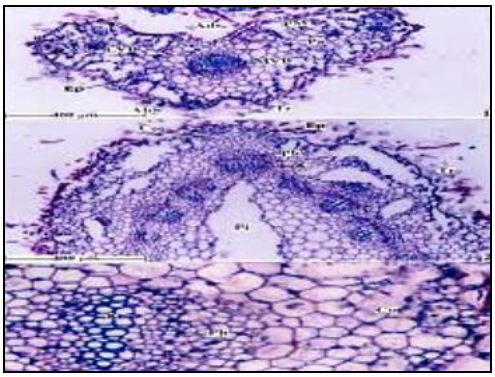

Fig 8: Anatomy Of Petiole And Stem

11. Phytochemical review

Phytochemical test for hexane, chloroform, ethanol and chloroform water extracts showed the presence of proteins, amino acids, carbohydrates, tannins, phenolic compounds, flavonoids, saponins, and phytosterols. All extracts were found to contain more important chemical components for a variety of pharmacological activities (Mallavarapu et al., 1999).

Linalool is one of the main phytochemical constituents of Davan oil, along with davanone, davana-ether, and davana furan. Additionally, present are methyl cinnamate, ethyl cinnamate, 2-hydroxyisodavanone, bicyclogermacrene, davana ether, farnesol, geranyl acetate, sesquiterpene lactones, germacranolides, and others. From the stage of flower head and emergence to the start of seed set, the amount of (Z)-and (E)-methyl cinnamate, (E)-ethyl cinnamate, bicyclogermacrene, davana ether, 2- hydroxyisodavanone, and farnesol increased while those of davanone, the primary component of Davan oil, and linalool declined.

For the first time, five chemicals were found in Davana oil, they are geranyl acetate, (Z)- and (E)-methyl cinnamates, and (Z)-and (E)-ethyl cinnamates (Ruikar et al., 2011).

11.1 Volatile phytochemicals

Davana oil contains a variety of volatile phytochemicals that give it its is unique aroma and therapeutic properties. Among the primary volatile constituents, davanone and isodavanone are the two sesquiterpene ketones that give the oil its distinct aroma and antibacterial qualities. Other significant ingredients in davana oil, such as linalool and dehydro-linalool, which have calming and anti-inflammatory qualities in addition to a pleasant, flowery scent, make it beneficial for aromatherapy. Terpinen-4-ol, another volatile component, has antifungal and antibacterial properties that enhance the oil's use in dermatological and natural disinfection products. Davanafurans, artemone, and eudesmanolide also aid in the oil's medicinal properties, such as wound healing and immunological support (Shreyas et al., 2018[10]

11.2 Non-volatile phytochemical

In addition to its volatile components, davana oil contains non-volatile phytochemicals that support its medicinal properties. Saponins, which are naturally occurring emulsifiers, increase the oil's potential to calm skin. Alkaloid pharmacological effects provide them anti-inflammatory and pain-relieving qualities. Sterol glycosides are plant-based compounds that may help regulate cholesterol and promote a healthy metabolism. The oil's antibacterial and astringent properties, which aid in wound healing and skincare, are a result of its tannin content. Additionally, phenols contain antioxidant and anti-inflammatory qualities, while mucilage hydrates and protects the skin. These non-volatile phytochemicals have additional health benefits, such a being used in traditional medicine, cosmetic items, and natural remedies for a variety of ailments (Kumara et al., 2023)[10].

i. Test for phenols

Two millilitres of distilled water were added to one millilitre of sample solvent extracts, and then a few drops of a 10% aqueous ferric chloride solution were added. Phenols were present when blue or green colour formed[16]

ii. Test for flavonoids

5-6 drops of a 5% quos ferric chloride solution were added along with 1 millilitre of extract[17].

12. Pharmacological review

12.1 Antimicrobial properties

Numerous scientist have thoroughly documented Davana oil's antimicrobial properties. The effectiveness of Davan oil against a variety of microbiological species, including both gram-positive and gram-negative bacteria and different strains of fungi, was examined by Bail et al.,(2008). According to their research , davana essential oil showed strong antibacterial activity that might be better than that of traditional antibiotics or antifungal drugs. Additionally, they reported on particular bioactive substances that were discovered by gas chromatography mass spectrometry(GC-MS) study and are in charge of the oil's antibacterial qualities.

These substances which include monoterpenes and oxygenated sesquiterpenes, are well known for their capacity to damage microbial cell membranes and imped growth. Given it's strong antibacterial properties, the study may also point to potential uses of Davana oil in food preservatives,
pharmaceuticals, personal care items, or natural disinfectants. When the Xchlorhexidine, the ethanol extract demonstrated higher promise against microbial sickness in the oral cavity, indicating significant antibacterial action against oral cavity illness(Yogendra et al., 2024)[10].

Davanone. A significant constituent of Davana oil, possess antifungal and antibacterial qualities(Schmidt et al., 2010). According to Vajs et al. (2004), davana essential oil exhibits antibacterial activities against Salmonella enterica subsp.enteric, pseudomonas aeruginosa, staphylococcus aureus, and the yeast candida albicans. In contrast to the others strain, the compounds highest activity against S. aureus had a minimum inhibitory concentration (MIC) value of 12.78 M, according to a recent study that tested the Davana root acetone extract and its isolate against S. aureus, B. subtills, p. aeruginosa, and E.coli(Kalaiselvi et al., 2010)[12].

12.2 Anti-inflammatory

Diabetes, coughing, colds, measels, melancholy, and high blood pressure have all long been treated with davana oil. Numerous research have demonstrated its analgesic and anti-inflammatory properties. Davana's methanolic extract showed potent anti-inflammatory effects on rat's carrageenin-induced paw edema, demonstrating that its saponnins and flavonoids give it analgesic and anti-inflammatory qualities. Additionally, it has potent analgesic properties. (Singh et al., 2022)[10]. In HaCat cell lines, davana oil and davanone showed a significant dose-dependent pro-inflammatory cytokine inhibitory potential(Singh et el., 2021). By engaging with important biological pathways that control the body's immune and inflammatory responses, certain bioactive chemicals, like limonenecadinol, which is found in both pepper and davana, aid to reduce inflammation, discomfort, and swelling(Vasantharaj, 2024)[13]

12.3 Anti-diabetic

The plants anti-diabetic qualities may be clarified by the identification of multiple natural compounds that may be involved in the management of diabetes. In both glucose-fed hyperglycemic and alloxan-induced

diabetes rats, oral treatment of a methanol extract of the aerial portions of *Artemisia pallens* Wall, which has been employed in Indian traditional medicine to treat diabetes mellitus, singnificantly lowers blood glucose levels[11]. It was discovered that the extract has a dose-dependent impact. In normal rats who were fasted, the extract caused significant hypoglycemia at higher dosages, but the water extract has no effect. Because of its anti-diabetic qualities, the methanolic extract of *A. pallens* appears to be the best choice for creating anti-diabetic drugs[15].

12.4 Anti-oxidant

Chemicals known as anti-oxidants easily binds to free radicals and stop the chain reaction from damaging essential elements. Selenium, vitamin A and associated carotenoids, vitamin C, vitamin E, and other phytochemicals like lycopene, lutein, and quercetin are examples of dietary anti-oxidants. Additionally, they are believed to prevent cataracts, rheumatoid arthritis, Alzheimer's disease, cancer, heart attacks, strokes. The plant *Artemisia pallens* is advantageous. They are medicinal and botanical use for Artemisia essential oils. Traditional medicines use the base, stem, bark, leaves, fruits, nuts, and seed oil to treat a variety of illness. Through the use of spectrophotometric tests, the anti-oxidant activity of different extracts is evaluated. The findings of the nitric oxide and DPPH assays demonstrate the anti-oxidant properties of *Artemisia pallens* root extracts[11,14].

12.5 Anti-cancer

With an IC50 of up to 10g/ml, saponins are plant glycosides that inhibit the growth of tumor cells by causing cell cycle arrest and death. It was found that the downregulation of the anti-apoptotic protein Bcl-2 permitted caspases to function. The number of new saponins that have been identified and extracted is continuously rising, and many more will be discovered soon as a result of better purification and detection methods. Saponins have anti-cancer properties that could aid in a creation of more potent cancer treatments. Give that some research has indicated additive or even synergistic efficacy between saponins and other anti-cancer medications, combining them could be a major advancement in the treatment of cancer. These combination could significantly increase the options for cancer treatment[10].

12.6 Anti-corrosive

When applied to mild steel in 1M HCl at a 200 mg/L amount, davana aqueous-methanolic extract and arbutin shown strong anticorrosive activity (94%) (87). The best anti-corrosive agents were a mixture of arbutin and davana methanolic extract[21].

12.7 Anti-helminthic

DEO exhibits potent anthelmintic efficacy against roundworms (Ascaris lumbricoides), tapeworms (Taenia solium), and earthworms (Pheretima posthuma) (105). It has been discovered that hydroxy precursors, synthesized davanone, and DEO act as arthropod deterrents against disease vectors (106). All things considered, A. pallens is a valuable plant with potential medicinal uses in a variety of fields due to its diverse biological activity. [21]

13. CONCLUSION

Artemisia pallens is a valuable medicinal plant with pharmacological potential. Its essential oil and extracts have promising application in medicine, cosmetics, and perfumery industries. The plant has demonstrated significant antimicrobial, anti-inflammatory, antioxidant and other biological effects. The multidimensional properties of Artemisia pallens position is asignificant resource in natural products-based drug discovery.

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