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Review

Yarrow: A Natural Panacea – Unveiling The Profile, A Versatile Herbal Medicine, Cosmatic Value

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Abstract

Yarrow (Achillea millefolium), a flowering plant belonging to the Asteraceae family, has long been recognized for its diverse therapeutic and cosmetic applications. Historically associated with wound healing since the time of Achilles, yarrow is rich in phytochemicals such as flavonoids, phenolic acids, alkaloids, and essential oils, contributing to its anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties. Its essential oil, aqueous extracts, and flower components are widely used in skin creams, shampoos, and anti-aging products for their soothing, moisturizing, and regenerative effects. Yarrow also aids in managing oily skin, enhancing skin tone, reducing pigmentation, and supporting sensitive skin care. Beyond dermatological use, it offers traditional medicinal benefits for gastrointestinal, hormonal, and stress-related disorders. The plant's microscopic and anatomical traits like trichomes and vascular bundle patterns support its authentication and purity verification against adulteration. Ethnobotanical records highlight its historical use in cultures worldwide, while modern studies confirm its pharmacological relevance. Despite its low toxicity, caution is advised due to potential allergic reactions and interactions with medications. Yarrow's versatility as both a medicinal herb and cosmetic agent underscores its significance in both traditional healing systems and contemporary formulations.

Keywords: Achillea millefolium, Cosmetic applications, Antioxidant properties, Ethnobotany, Anti-inflammatory, Herbal medicine.

INTRODUCTION

One of the global marketplaces with the fastest rate of growth is the cosmetics industry. Over the last five years, skin care product sales have increased. The desire to take care of oneself and prevent the aging effects of the skin, which is encouraged by social media and the advancement of societies, is directly linked to consumers' growing awareness of the detrimental effects of various environmental factors on skin condition and their growing interest in this sector of the economy. The primary function of the active chemicals included in contemporary cosmetics is to shield the skin from UV rays, air pollutants, and shifting weather conditions like [temperature and wind] or lessen the annoyance brought on by outside influences and assist the processes of regeneration. Given the aforementioned information, it is imperative to bring novel cosmetic components to market that will minimize environmental stressors that the skin is constantly exposed to, lessen skin irritation and hyperpigmentation, and enhance skin regeneration and rejuvenation. Plant-derived chemicals from organic farms have made a comeback in cosmetics and medications in recent years. The phrase "naturally derived" has a positive connotation for customers and ensures strong product sales. Achilles Millefolium, commonly known as Yarrow is a flowering plant in the family Asteraceae. The genus Achillea has good old days of use in ethic medicine as a natural remedy in the dermatology and skin care. [1-6]

Fig 1: Yarrow (Achillea millefolium)

History

The genus name Achillea is derived from the Greek mythological term Achilles, and the specific epithet millefolium describes various leaf or foliage parts. Evidence of human use dating back to prehistoric times has been revealed in 60,000-year-old burial caves in Europe, where yarrow pollen was discovered. The plant's extract was employed by Greek mythological hero Achilles to stop the bleeding from his battle wounds, hence the genus Achillea. The word "millefolium" means "thousand-leaved" in Latin, referring to the foliage's feathery cuts. There are numerous other names for common yarrow, including milfoil, devil's nettle, and soldier's woundwort. Many different species and hybrids of yarrow with a range of characteristics make it a popular plant in attractive flower gardens. [fig,1.1] Though they can also be pink, crimson, cream, and yellow, flowers are usually white[7] Among the yarrow species, Achillea millefolium L. [common yarrow] extracts are the most well-known; nevertheless, recent studies have revealed that other Achillea species also have biological qualities that make them useful for dermatological and cosmetic purposes. Many phytoconstituents, including flavonoids, phenolic acids, alkaloids, sterols, terpenes, and tannins, are present in Achillea millefolium. The raw material has a high concentration of phenolic acids and flavonoids among all the phyto-compounds. This plant has been shown to contain many flavonoid glycosides and aglycones. The flavonoid glycoside consists of sweticin, vitexin, and vicenine. Flavones, flavonoids, and lignans have been observed to be abundant in many Achillea species. It has various application in cosmetic that are soothing, facial creams, lotions, shampoos [9] Although asteraceous plants are found all over the world, they are more prevalent in lower temperate and subtropical regions that are arid or semi-arid in climate. Achillea is a plant that grows in temperate regions of Asia, Europe, and some parts of North America. It has about 130 species, both perennial and blooming. These plants usually feature flat clusters of tiny blooms at the top of the stem, along with hairy, scented leaves. Many kinds of these flowers are popular garden plants because of their diverse coloration. This genus's fundamental chromosomal number is X=9, and the majority of its diploid species have extensive ecological ranges that span from arid deserts to wetland areas.[7]

Scientific calssification [8]

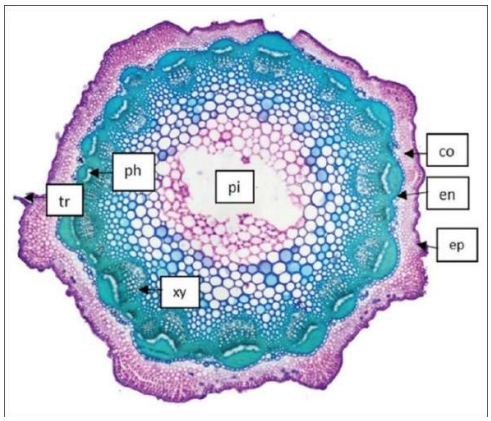
Kingdom : Achillea
Family : A. millefolium
Genus : AchilleamillefoliumL
Species : Binomial Name
Plantae : References Species
Asteraceae : Plantarum 2: 899 L

Common names of yarrow [8]

Green yarrow	Mile foil
Noble yarrow	Nosebleed plant
Sanguinary	Solder's woundwort
Thousand leaf	Yarrow

Microscopic character

Transverse section of stem: The stem's transverse section displays a ring with ridges and furrows. It is made up of the central pith, cortex, vascular system, and epidermis. The outermost layer of the epidermis is single-layered, composed of cells with square to rectangular shapes, coated in non-glandular trichomes and cuticle. Trichomes have smooth walls, a bulbous basal cell, 4-6 short stalk cells, one long terminal cell with a pointed tip, and are unbranched, uni-seriate, multicellular, and measure between 300 and 600 µ in length. Inner parenchyma and outer collenchyma are two distinct types of cortex. The thick-walled, lignified, clustered pericycle fibers with a visible lumen are a discontinuous circle. The vascular zone, consisting of inner and outer xylem, comes next. The narrow phloem is composed of tiny, thin-walled, and spherical to polygonal shaped cells. Vesicles, structural strands, fundamental tissue cells, and vascular rays are visible in xylem. Rays are either biseriate or uniseriate at times. The majority was composed of hollow or round-to polygon-shaped parenchyma cells with thin walls. [Fig 2]



outer epidermis[ep]; cortex[co]; phloem[ph]; trichome [tr]; xylem[xt]; pith[pi]

Fig 2: Transverse section of stem

There are a lot of covering trichomes and not many glandular trichomes in the stem epidermal peel. [Fig 2]

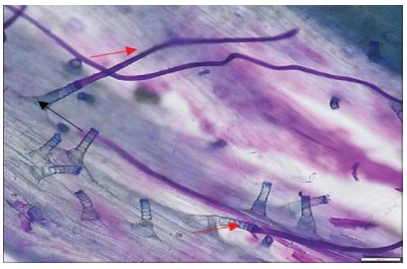
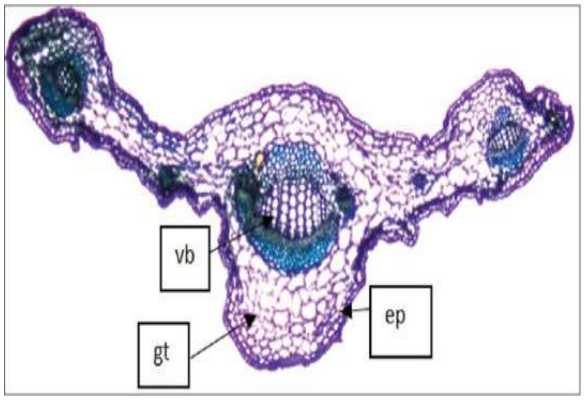


Fig 2.1 Epidermal peel of leaf stained with non-glandular trichomes

Pinnatisect leaf cross sectionIt displays a "T" shaped outline, with the vascular bundle and ground tissue enclosed by the upper and lower epidermis. The epidermis consists of a single layer of square-shaped cells covered by a cuticle, featuring trichomes similar to those on stems, along with a few glandular trichomes. The ground tissue differentiates into two distinct cell types: loosely arranged parenchyma cells with thin walls and intercellular spaces, and an outer layer of 2-3 compactly packed collenchyma cells. The vascular system includes three bundles: one central bundle and two accessory bundles located in each corner. Each vascular bundle is flanked on both sides by a discontinuous layer of sclerenchymatous bundle cap cells. The epidermis of the leaves shows both glandular and non-glandular trichomes. [Fig 3]



outer epidermis ([ep]; inner tissue [gt]; central vascular [vb]

Fig 3: Cross section of compound leaf

The black, spherical bodies of glandular trichomes are accompanied by anomocytic, somewhat wavy epidermal cells in the stomata. [fig 4].

Fig 4: Epidermal peel of leaf with glandular trichome

Portion transverse to the peduncle:It displays the outer epidermis, cortex, vascular region, and central hollow pith. [fig 1.5] It exhibits a circular form with prominent ridges and furrows, highlighting the outer epidermis, cortex, vascular region, and a central hollow pith The epidermis is a single layer composed of round to polygonal cells, with long, unbranched, covering or non-glandular trichomes. Patches of parenchyma cells follow patches of collenchyma cells in the cortex of ridges. The cortex differentiates into parenchymal and collenchymal cells in grooves. While the stele and stem are similar, the stele has a wider pith. [fig 5]

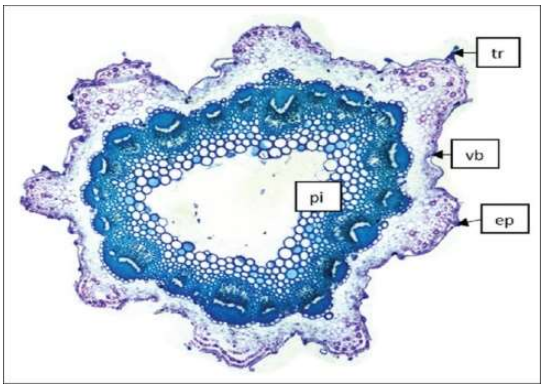


Fig 5: TS of peduncle.

Different parts of plant that has cosmetic value

Flowers: Flowers are a great source of flavonoids and sesquiterpene lactones, which have therapeutic, astringent, and anti-inflammatory qualities. They are frequently found in anti-aging cosmetics, facial steams, and skin tonics.[10]

Vital Oil: The anti-inflammatory, antibacterial, and cicatrizing [wound healing] qualities of yarrow essential oil make it valuable. It is frequently included in formulas for burn, scar, and irritated skin treatment. [11] Extract from the leaves and flowers of Achillea millefolium Antidandruff, cleansing, masking, refreshing, skin conditioning, and toning are some of the qualities of this extract. It is frequently used to condition the skin and support healthy scalps.

Achillea Millefolium Flower Water (aqueous solution made by steam distilling the flowers): This flower water is commonly used in cosmetics because of its masking properties, which provide the skin with a calming and revitalizing feeling.

Flower Extract from Achillea Millefolium (flower extract): This extract, which is well-known for its humectant and antioxidant qualities, hydrates the skin and shields it from environmentals[1]

Plant occurance

A. millefolium, which has over 85 species primarily found in Europe, Asia, and North America, is native to Europe and western Asia and is also common in many temperate regions, including North America (13). A. millefolium usually grows at elevations of 3500 meters and is frequently seen in open woodlands and meadows. Typically, the plant grows actively in the spring and flowers in May or June.

Secondary metabolites: Numerous substances are present in it, such as beta-pinene, alpha alphaterpineol, luteolin-7-O-beta-D-glucuronide, borneol, camphor, eucalyptol, alkaloids, glycosides, choline, volatile oil, azulene, chamazulene, salicylic acid, sesquiterpenoids, dicaffeoylquinic acids (DCCAs), artemetin, dihydrodehydrodiconiferyl alcohol 9-O-beta-Dglucopyranoside, and apigenin. [12]

Adulteration

These days, adulteration in sold medicinal plants is a serious problem, and using these adulterated plants might have negative effects on the end user. This issue can be solved, though, by making sure that the traded medicinal plants that are used to make various herbal remedies are identified. Role of Taxanomic Tool in Authentication:In this sense, taxonomic tools such as palynological markers are thought to be crucial for distinguishing the original medicinal plant from its adulterant. In order to differentiate specific medicinal plants from their adulterants, this study set out to identify specific, trustworthy palynological markers. Medicinal Plants pairs and adulterants: These include the following: Artemisia maritima versus Artemisia absinthium, Achillea millefolium versus Adhatoda vasaka, Sphaeranthus indicus versus Sphaeranthus africanus, Averrhoa carambola versus Butea monosperma, and Cinnamomum verum versus Canella winterana, Cinnamomum tamala versus Cinnamomum obtusifolium, Gymnema sylvestre versus Gymnema lactiferum,Averrhoa carambola versus Butea monosperma, Achillea millefolium versus Adhatoda vasaka, Sphaeranthus indicus versus Sphaeranthus africanus, and Morus nigra versus Morus alba are some examples of the plants that are in conflict.

Difference in pylonogical characteristics

The genuine medicinal plant and its adulterant showed significant differences in several palynological characteristics, including pollen size, shape, colpi length, exine, intine thickness, and fertility. Pollen from A. millefolium was discovered to be round to spheroidal in shape in $_{the}$ equatorial view, but pollen from A. vasaka was found to be oblate. Comparably, the pollen of B. monosperma measured 34 μm, while that of its adulterant A.

carambola measured 21 µm. Additionally, A. maritima's colpi length was 11.8 µm, while A. absinthium's was 4.5 µm. Thus, it may be said that palynological characteristics are incredibly useful for identifying real therapeutic plants. [13]Characteristics and its species:In the temperate and boreal zones of the northern hemisphere and, to a lesser degree, the southern hemisphere, yarrow is a common herb that grows in fields and urban waste places. The most common variation is Achillea millefolium L. sensu stricto, or Achillea millefolium L. s.str. It is extensively distributed throughout central and northern Europe, scarce in southern Europe, and has been brought into North America on a large scale. [14] Worldwide perennial Achillea millefolium L., sometimes called yarrow, thrives in temperate parts of North America, Australia, and Eurasia. It is among the first botanicals that people are known to have used. A. millefolium is most frequently found in meadows, roadsides, slopes, field margins, and wastelands in Poland, despite the fact that it may be produced as a beautiful land spice plant [15]. Yarrow usually grows between 20 and 90 centimeters tall and is characterized by its fine, fern-like leaves, long hairy stems, and clusters of small white or pale-yellow flowers at the top. [fig 6]

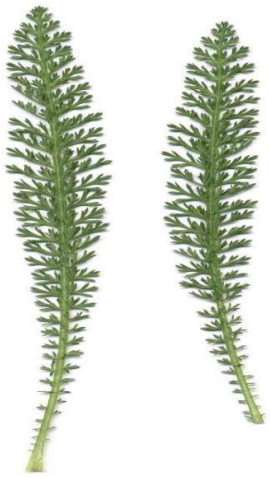


Fig 6: Phytoconstituents

Phytoconstituents [9,1]

Constituents	Description
Flavonoids	Antioxidant compounds that protect cells from damage
Saponins	Compounds with potential anti- inflammatory effects
Essential oil	Includes alpha-pinene, beta- caryophyllene, etc.
Tannis	Polyphenolic compounds with astringent properties
Sesquiterpene lactones	Compounds with potential anti- inflammatory properties
Alkaloids and glycosides	Which contribute to its antimicrobial and wound healing abilities

Ethnobotanical overview: Historical And Cultural Significance

Ancient Civilizations: For thousands of years, people have utilized yarrow. Yarrow's genus name, Achillea, comes from its association with the Greek hero Achilles, who is supposed to have used the plant to heal wounds sustained during combat. Writings from Greek, Roman, and Native American societies, where the herb was prized for its therapeutic qualities, provide insight into its historical significance. Sacred and Protective Functions: Yarrow was also thought to have protective properties in many cultures. For instance, it was frequently carried or positioned in homes for spiritual protection and was used to ward off evil spirits. Divination: According to the I Ching, yarrow was utilized in divination in ancient China. Yarrow stalks were used to cast lots in order to find the solutions[16]. Wound Healing: Yarrow has been used for thousands of years to treat cuts, scratches, and wounds. Its hemostatic, antimicrobial, and anti-inflammatory properties help reduce bleeding and promote healing. A research in the Journal of Ethnopharmacology suggests that because of its anti-inflammatory qualities and hemostasis (the ability to stop bleeding), it may hasten wound healing[17]. Anti-inflammatory Effects: Yarrow contains compounds with anti-inflammatory properties, including flavonoids, alkaloids, and essential oils. Inflammatory diseases like arthritis and gastritis can be treated with it. An investigation that was published in Phytotherapy Research found that yarrow reduces inflammation in animal models. Sesquiterpene lactones and flavonoids found in yarrow have analgesic and anti-inflammatory properties that, in animal models, lessen pain and inflammation. Antispasmodic and anti-inflammatory properties: Yarrow's

flavonoids and terpenoids relax smooth muscles, reducing spasms and inflammation[18]. Digestive Health: Yarrow has long been used to treat digestive problems, including bloating, constipation, and indigestion. It is said to encourage the production of bile, which makes digestion easier. According to studies published in The Journal of Medicinal Food, the plant has been used to treat gastrointestinal problems due to its mild anti-inflammatory qualities. Its essential oils protects the gastric mucosa against ethanol-induced ulcers.[19,20] . Hormonal and menstruation Balance: Yarrow is commonly used to reduce cramps and regulate menstruation cycles. It may help with hormone balance because of its suspected mild estrogenic activity. A Fitoterapia study suggests that yarrow may improve women's reproductive health by affecting hormone activity. Inhibit the growth of pathogens causing vaginal infections.[21] Antibacterial Properties: Due to its demonstrated antibacterial qualities, yarrow can be utilized to treat infections. Its ability to combat bacteria, fungi, and viruses has been studied. Microorganisms released an assessment of yarrow's essential oils' antibacterial properties. Reduction of Stress and Anxiety: Yarrow has long been used as a mild sedative to lessen stress and anxiety. Compounds in the herb have the potential to soothe the neurological system. According to a study published in Neuropharmacology, yarrow's calming effects are caused by anxiolytic qualities found in several of its components. Fever Reduction: By promoting perspiration, which lowers body temperature, yarrow is occasionally used to cure fevers. Its diaphoretic qualities serve as the foundation for this. According to a review published in The Journal of Alternative and Complementary Medicine, yarrow's ability to induce sweat may help lower fever.[22]

Traditional uses

An essential medicinal plant in the Unani (Greco-Arab) medical system, A. millefolium has been used for hundreds of years as herbal teas for hepatobiliary disorders, headaches, gastrointestinal problems, and appetite enhancement, as well as externally as lotions and ointments to treat cuts, abrasions, wounds, and skin inflammations.

A. millefolium has long been utilized as a traditional herbal cure, even in veterinary care.Infusions, decoctions, or fresh juices have been used to treat anorexia, stomach cramps, flatulence, gastritis, enteritis, wounds, sores, skin rashes, internal and external bleeding (bloody cough, nosebleed, hemorrhoidal and menstrual bleeding, bloody urine), and dog and snake bites. Even in veterinary medicine, A. millefolium has long been used as a traditional herbal remedy. Anorexia, stomach cramps, flatulence, gastritis, enteritis, internal and external bleeding (bloody cough, nosebleed, hemorrhoidal and menstrual bleeding, bloody urine), wounds, sores, skin rashes, and dog and snake bites have all been treated with preparations in the form of infusions, decoctions, or fresh juices. It has been applied physically as a lotion, ointment, or poultice and orally, typically as a tea. In European and Asian traditional medicine, the aerial portions of A. millefolium, a well-known species among other Achillea members, are frequently used to treat gastrointestinal issues, hepatobiliary complaints, wound healing, and skin inflammations.[23]

Cosmetic Uses

Skin Rejuvenation: When The Dermal Matrix And Epidermal Structure Are Better Structured, The Skin Becomes Smoother, More Toned, And Tense. This Is Known As The Skin Rejuvenation Effect. A. Millefolium Extracts Had The Most Skin-Rejuvenating Efficacy.[24]

Anti Oxidant: Flavonoids, Whose Glucosides And Phenolic Acids Are Recognized As The Most Potent Antiradical Metabolites, Are Abundant In Achillea Preparations. Achillea Extracts And Their Metabolites Have Been The Subject Of Numerous Investigations To Far, Which Have Shown The Genus's Potent Antioxidant Qualities. Derivatives Of Caffeoylquinic Acid Are Among The Most Abundant Antioxidant Phytochemicals Present In Extracts From A Number Of Achillea Species. [25,26,27]

Skin Lightening Property: Since A. Millefolium Ethyl Acetate, Methanol, And Water Extracts Inhibit mushroom tyrosinase in vitro with IC50 values of 31.57, 23.26, and 15.23 mg of kojic acid equivalents (KAE)/g, they may have skin-lightening properties. This activity is caused by the essential oil of A. millefolium.[28,29]

Sensitive skin: For skin that is delicate and prone to irritation, yarrow extract can be soothing and regenerative. Additionally, it possesses antibacterial and pain-relieving qualities that make it beneficial for massaging cells, liniments, and mending slaves.[30]

Flowers Use in Cosmetics: Rich in flavonoids and tannins, yarrow flowers offer anti-inflammatory, astringent, and antioxidant qualities. These find application in skin-soothing, anti- reddening, and wound-healing products.[31]

Controls Sebum Production: Yarrow is beneficial for those with oily or acne-prone skin because it helps to balance the skin's oil production. By reducing sebum production, yarrow helps prevent breakouts and blocked pores.[32]

Hydration and Moisture Preservation: Extracts from yarrow help to keep the skin's moisture barrier intact by providing it with moisture. This can make the skin softer and more supple by reducing dryness and increasing general skin moisture.[33]

Skin Tone and Texture Enhancement: Regular use of yarrow in skincare regimens can improve skin tone and texture by reducing hyperpigmentation and discoloration, leading to a more even skin tone and healthier-looking skin.[34]

Ethnopharmacological Significance and Medicinal Uses of Achillea Species

The genus Achillea is found throughout the world, and locals have utilized its species as traditional herbal remedies or folk remedies. In Persian, Bumadaran is a common name for a number of Achillea species. In Persian traditional literature, they are described as tonic, anti-inflammatory, anti-spasmodic, diaphoretic, diuretic, and emmenagogic drugs that have been used to treat wound healing, rheumatic pain, pneumonia, and bleeding. Due to the form of the leaves, A. millefolium L. is known as plumajillo, or "little feather," in southern Colorado and Spanish-speaking New Mexico. Because of its astringent properties, which helped in wound healing and bleeding prevention, yarrow was employed by Native Americans and early settlers. There are three primary activities of Achillea: Tonify Deficiency (tonic), clear Exterior Wind (diaphoretic), and clear Heart Phlegm (anti-hypertension). New clinical and experimental research have validated several of these medicinal uses. Herbal teas made from various Achillea species are frequently used in folk medicine, particularly to treat gastrointestinal disorders. Linoleic acid, a necessary polyunsaturated fatty acid, is abundant in the high oil content of yarrow seeds. Because of this, yarrow seed has the potential to produce edible oil that can be consumed by humans.Because A. millefolium contains the flavonoids luteolin V and apigenin VI, it has just been offered as a novel natural dye source for wool dyeing. In Iran, it was discovered that A. millefolium has significant agronomic potential as a natural dye.[35]

Adverse Effects

Human Toxicity and Contact Dermatitis Symptoms: The flower and leaves of Achillea millefolium are considered to have low poison severity in humans, but may cause contact dermatitis, with symptoms including increased urination, vomiting, diarrhea, dermatitis, depression, anorexia, and hypersalivation.[36]

Allergic Contact Dermatiti: Yarrow can cause allergic contact dermatitis, a skin reaction that can lead to redness, itching, and blistering[37]

Photosensitivity: Yarrow can also cause photosensitivity, a condition that makes the skin more sensitive to sunlight, leading to sunburn, blistering, and skin discoloration.[38]

Digestive Issues: Consuming large amounts of yarrow can cause digestive issues, including nausea, vomiting, diarrhea, and stomach cramps[39]

Interaction with Medications: Yarrow can interact with certain medications, including blood thinners, diabetes medications, and blood pressure medications, which can lead to adverse effects.[40] Yarrow is not recommended for use during pregnancy and breastfeeding, as it may stimulate the uterus and cause bleeding pregnancy and breastfeeding.[41]

CONCLUSION

Yarrow (Achillea millefolium) stands out as a versatile and time-honored medicinal herb with significant pharmacological and cosmetic value. Rich in bioactive compounds such as flavonoids, essential oils, and alkaloids, it demonstrates strong anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties. These attributes make it especially beneficial in dermatological applications, including skin rejuvenation, hydration, lightening, and treatment of sensitive or acne-prone skin. Its widespread use across cultures for gastrointestinal issues, hormonal balance, stress relief, and traditional healing highlights its ethnopharmacological importance. Moreover, yarrow's presence in modern skincare products validates its continued relevance and efficacy. Scientific validation of its phytoconstituents and microscopic characteristics further supports its role in authenticated herbal medicine and combats issues of adulteration. While generally considered safe, awareness of potential side effects such as allergic dermatitis and photosensitivity is essential, particularly when used alongside certain medications. Overall, Achillea millefolium remains a natural, multifunctional remedy that bridges traditional knowledge with modern therapeutic and cosmetic innovations.

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