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HERBAL INTERVENTIONS FOR DERMATOLOGICAL DISORDERS

Shivanshi Chauhan and Richa Srivastava *

Amity Institute of Pharmacy, Lucknow, Amity University Uttar Pradesh, Sector 125, Noida - 201313, Uttar Pradesh, India.

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Correspondence to Author:
Dr. Richa Srivastava

Assistant Professor,
Amity Institute of Pharmacy,
Amity University, Lucknow Campus - 226010, Uttar Pradesh, India.

E-mail: richasri12@gmail.com

ABSTRACT: Herbal medicines have gained recognition for their potential in treating various skin disorders, driven by both traditional practices and modern scientific research. The efficacy of these natural remedies can be attributed to their diverse chemical compositions, which often include bioactive compounds with antimicrobial, anti-inflammatory, and antioxidant properties. The skin is the body's largest organ which serves essential functions which include protection, temperature regulation, and sensory perception. This systematic review evaluates the effectiveness of herbal medicinal plants and their formulations in treating various skin disorders, leveraging India's rich botanical diversity. Herbal remedies have gained traction in modern healthcare due to their adaptability, reduced side effects, and efficacy in managing conditions such as acne, eczema, psoriasis, vitiligo, and skin infections (microbial, fungal, and bacterial). This review highlights the therapeutic potential of plant-based treatments and their benefits over conventional options. It underscores the role of traditional herbal medicine in providing viable, less invasive solutions for skin health, and supports its integration into contemporary treatment strategies.

INTRODUCTION: Skin diseases represent a significant global health concern, affecting millions of individuals and often leading to physical discomfort and psychological distress. The treatment landscape for these conditions has evolved, with a growing interest in herbal remedies and traditional medicine as viable alternatives or complements to conventional therapies. This shift is particularly pronounced in regions where access to modern medical facilities is limited, and traditional practices remain integral to healthcare.

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The World Health Organization (WHO) estimates that over 80% of the population in developing countries relies on traditional medicine for their primary health needs, highlighting the importance of ethnopharmacological studies in understanding the role of medicinal plants in treating skin disorders. The skin is made up of several layers, including the dermis, hypodermis, and epidermis. Its essential functions include safeguarding the body and regulating temperature while enabling sensation.

Skin disorders are a prevalent issue, affecting around half of adults at some stage, with one in three experiencing a persistent or minor condition [1-5]. Research has demonstrated that various herbal remedies possess anti-inflammatory, antimicrobial, and healing properties that can be beneficial for skin diseases. For instance, studies have identified

plants such as *Curcuma longa* are effective in treating multiple skin ailments. Furthermore, traditional Persian medicine has been shown to support the use of natural remedies, including whey protein, for inflammatory skin conditions like acne vulgaris. The application of herbal poultices, as noted in ethnopharmacological surveys, is a common practice for treating skin infections, underscoring the practical aspects of traditional medicine. Skin disorders pose significant challenges to the quality of life for both adults and teenagers [6-10]. In the Indian system of medicine, herbal plants contribute to the growing economic value of healthcare. Our diverse climate has provided us with a rich array of medicinal herbs that offer remedies for various ailments and disorders. Herbal medicines have gained prominence in modern healthcare due to their increased adaptability and acceptance among people, along with their relatively lower incidence of side effects [11-16]. Plant-based herbal remedies have demonstrated effectiveness in treating skin disorders, including acne, eczema, skin cancers, psoriasis, trauma, and vitiligo, as well as microbial, fungal, and bacterial skin infections [17-20].

Skin: The skin serves as the body's crucial defence mechanism against environmental threats, whether natural or human-made. Additionally, it serves as a primary site for medical interventions and nursing care, facilitating tasks such as transdermal drug delivery, device attachment, and monitoring of various physiological functions. Primarily, the skin's role involves preventing the infiltration of microorganisms by forming a physical barrier against the external environment. Beyond physical protection, the skin's defensive mechanisms also encompass immunological, metabolic, and UV protective functions [21-25]. The skin primarily comprises three layers:

Epidermis: This layer is the outermost layer of the skin, visible to the naked eye. It undergoes continuous renewal as dead skin cells shed and are replaced by new, healthy cells. It contains different types of cells, including melanocytes, which produce the pigment melanin responsible for skin coloration, squamous cells forming the outermost layer Referred to as the stratum corneum, and basal cells situated beneath the squamous cells at the bottom of the epidermis. Various conditions affecting this layer can be attributed to factors such as bacteria or genetics, leading to boils, acne, dandruff, psoriasis, and skin cancer [26-30].

Dermis: The middle layer of the skin is called the dermis. At the basal membrane, the epidermal layer connects to the dermis, forming layers known as the papillary and reticular layers. The papillary layer is the thinner, uppermost layer comprising loosely bonded connective tissues primarily linked to the epidermis. In contrast, the reticular layer is thicker with fewer cells and mainly consists of bundles of deeper connective tissues. The dermis contains various structures such as blood vessels, hair follicles, sweat glands, neurons, lymphatic vessels, muscles, fibroblasts, nerves, elastin, and collagen. Its primary role is to provide strength and flexibility to the skin while housing touch and pain receptors. Conditions associated with this layer include wrinkles, bacterial infections, and dermoid cysts.

Hypodermis: This layer lies deeper than the dermis and is often referred to as the subcutaneous fat layer or fascia. It primarily consists of blood vessels, neurons, and hair follicles. Serving as a deeper layer of the skin, it functions as a reservoir for fat and collagen cells. Its primary role is to protect the body from external shocks and injuries while aiding in maintaining body temperature by providing insulation [31-34].

Functions of the Skin:

1. The skin serves as the body's initial defence mechanism against ultraviolet light, microorganisms, mechanical damage, and dehydration. It serves as the main physical barrier safeguarding the human body from the external surroundings.

2. The skin enables sensation, allowing us to perceive deep pressure, temperature, pain, and touch.

3. Mobility enables seamless movement of the body.

4. The skin engages in endocrine activity by initiating biochemical processes necessary for production of vitamin D. It is essential for

healthy bone metabolism and the absorption of calcium.

5. The skin releases ammonia, urea, and water to carry out exocrine action. It also secretes things like sweat, pheromones, and sebum. Furthermore, the skin plays a vital role in immunological functions by secreting bioactive substances such as cytokines.

6. The skin contributes to the development of immunity against pathogens.

7. Regulation of temperature: The skin plays a crucial role in thermal regulation by conserving or releasing heat, thereby aiding in maintaining the body's water and homeostatic balance [35-40].

Mechanism of Drug Absorption: The dosage form of the drug releases the medication, starting a series of processes that guide it towards the dermis to address skin conditions. Phytoconstituents partition and diffuse into the dermis after penetrating through the epidermal layer. Subsequently, these phytoconstituents enter the systemic circulation, where they are utilized for treating skin disorders [41-50].

Skin Disorders:

Bacterial Infections: The two most common types of bacteria responsible for these infections are streptococci and staphylococci. These bacteria can infect various parts of the skin, including epidermis, deeper skin layers, or hair follicles. If left untreated, these infections can potentially spread throughout the body, leading to more severe complications. Examples of such illnesses include Lyme disease, impetigo, folliculitis, and cellulitis.

Fungal Infections: Harmless fungi normally live on the skin's surface, but infections occur when these organisms penetrate deeper into the body. Usually, these infections are superficial, affecting the skin, nails, and hair, and can present as conditions like athlete's foot, jock itch, and ringworm. Nevertheless, in individuals with weakened immune systems or prolonged antibiotic usage, the fungi can proliferate deep within the body, leading to more severe diseases.

Viral Infections: These infections happen when a virus breaches the stratum corneum and moves into the inner layers of the skin. Examples include herpes simplex, warts, and shingles (herpes zoster). Additionally, systemic viral infections like chickenpox and measles can also impact the skin. It's important to note that viral infections cannot be treated with antibiotics.

Acne: Acne is a prevalent skin disorder characterized by the presence of pus-filled spots (pustules) and comedones (blackheads and whiteheads). Typically starting during puberty, its severity ranges from a few facial blemishes to a more widespread problem affecting the back and chest, impacting self-confidence and potentially leading to scarring.

Acne primarily affects individuals with oil-producing glands that are particularly sensitive to normal levels of the hormone testosterone, found in both males and females. This sensitivity prompts an overproduction of oil. Simultaneously, dead skin cells lining the pores fail to shed properly, leading to follicle blockage. The acne bacterium, Propionibacterium acnes, resides on everyone's skin without issue, but in individuals prone to acne, the excess oil provides an ideal environment for bacterial multiplication, triggering inflammation and the formation of red or pus-filled spots.

Tumors and Cancers: These growths occur when skin cells start multiplying at a faster rate as compared to the normal. However, not all skin growths are cancerous; some are benign and do not spread. Skin cancer is the most common type of cancer, affecting about 800,000 Americans each year. Sun exposure is the primary cause, accounting for 90% of cases. Three primary types of skin cancer exist malignant melanoma (the most lethal form), squamous cell carcinoma (which may spread if untreated), and basal cell carcinoma (often highly treatable). Prevention strategies include shielding the skin from harmful UV rays. Early detection significantly improves the chances of successful treatment; hence it is advisable to conduct regular self-examinations.

Trauma: Trauma refers to an injury inflicted on the skin due to a burn, a cut, or a blow burn. When the skin's surface is breached, the body becomes more vulnerable to infection and disease.

Psoriasis: Psoriasis is a chronic inflammatory skin disorder that was previously misunderstood and mistaken for leprosy. It significantly impacts a patient's quality of life and can affect their mental well-being. The condition may result from genetic factors or the excessive proliferation of skin cells. Psoriasis manifests in three main types: nail psoriasis, characterized by nail pitting and yellowing accompanied by severe thickening of the nails; skin psoriasis, which presents with symptoms such as yellowish small blisters and pus on the skin; and psoriatic arthritis, which entails bone erosion close to the joints.

Eczema: Eczema is a condition primarily characterized by changes in the epidermal layer of the skin, leading to symptoms such as scaling, redness, blistering, itching, crusting, swelling, oozing, thickening, and sometimes pigmentation. While it often resolves during childhood, it can persist into adulthood, reappear during adolescence or early adulthood, or even emerge for the initial time in adulthood. Eczema can impact any area of the skin, including the face and different body parts, but it typically appears most frequently on the inner creases of the elbows and knees, as well as the wrists and neck. Additional common signs of atopic eczema include isolated areas of inflammation resembling coins in size.

Pigmentation Disorders: The amount of pigment in the skin is controlled by the body's production of melanin. Hypopigmentation, or reduced pigment, can result from factors like a lack of melanocytes, malfunctioning cells, exposure to cold or chemicals, or specific infections. On the other hand, hyperpigmentation, or an increase in pigment, may result from hormonal changes, skin irritation, a metabolic disorder, aging, or other underlying issues. Examples of hyperpigmentation include melasma, freckles, and age spots, while vitiligo serves as an example of hypopigmentation [51-53].

Treatment Available: Skin disorders encompass a wide range of conditions that can significantly impact patients' quality of life. The treatment options available for these disorders vary depending on the specific condition, its severity, and the patient's overall health. This response synthesizes the available literature on treatments for various skin disorders, highlighting both pharmacological and non-pharmacological approaches.

One of the most common treatments for chronic inflammatory skin diseases, such as psoriasis and atopic dermatitis, involves the use of biologic therapies. These therapies have gained popularity due to their targeted action against specific pathways involved in inflammation, offering a favourable safety profile compared to traditional systemic immunosuppressants. For instance, the use of biologics has shown efficacy in managing conditions like hidradenitis suppurativa and pyoderma gangrenosum, where conventional treatments may fail. Furthermore, systemic treatments, including hydroxychloroquine (HCQ), have been explored for conditions like dermatomyositis, although their effectiveness can vary based on disease presentation.

Topical therapies remain a cornerstone in the management of many skin disorders. For atopic dermatitis, emollients are crucial for maintaining skin hydration and barrier function, while topical corticosteroids are commonly used to reduce inflammation during flare-ups. Recent advancements have also led to the development of newer topical agents, such as calcineurin inhibitors, which provide an alternative for patients who may not tolerate steroids well. The management of itch, a common symptom in many skin disorders, has been addressed through various topical treatments aimed at restoring the skin barrier and reducing inflammation.

Surgical interventions are also significant in the treatment of certain skin disorders. For example, wide surgical excision is a recommended approach for severe cases of hidradenitis suppurativa, particularly when conservative measures have failed. The integration of reconstructive techniques, such as skin grafting, can enhance outcomes for patients undergoing surgical management of chronic skin conditions.

In resource-limited settings, innovative solutions such as mobile health applications have emerged to improve the detection and management of skin diseases. These tools can facilitate early diagnosis and enhance patient education, ultimately leading

to better health outcomes. Moreover, training healthcare workers in dermatology has proven effective in improving the management of skin diseases in developing countries, highlighting the importance of education in addressing the global burden of skin disorders.

The treatment landscape for skin disorders is diverse, encompassing a range of marketed therapies that address various conditions, including atopic dermatitis, psoriasis, and skin infections. Topical therapies remain the cornerstone of treatment for many skin disorders. For instance, corticosteroids are widely used for their anti-inflammatory properties, particularly in conditions such as psoriasis and atopic dermatitis. They are available in various potencies, with class II-IV agents being significantly more effective than placebo in managing mild-to-moderate psoriasis. Additionally, topical agents like Aldara (imiquimod) have shown efficacy in treating basal cell carcinoma (BCC) and actinic keratosis (AK) through immune modulation, primarily via TLR7 activation. The role of compounded preparations is also significant; they provide tailored solutions for patients, particularly when commercially available drugs are ineffective or inappropriate. Moreover, the integration of probiotics into dermatological treatments has gained traction, with studies indicating their potential in managing inflammatory skin diseases by restoring the skin microbiome balance. The use of topical probiotics may enhance skin barrier function and reduce inflammation, thereby offering a novel therapeutic avenue for conditions like acne and rosacea. Novel formulations utilize nanotechnology as promising alternative. These formulations, including liposomes and solid lipid nanoparticles, facilitate targeted drug delivery, enhancing the bioavailability of poorly soluble drugs. Such advancements are crucial for treating chronic skin conditions, where effective penetration and sustained release of active ingredients are essential for therapeutic success.

Furthermore, the use of topical antimicrobials is critical in managing skin infections and preventing complications in wound care. Silver sulfadiazine remains a standard treatment for burn wounds, although alternatives like aloe vera are being explored for their cost-effectiveness and healing properties. The development of new antimicrobial agents, including those derived from natural products, is also an active area of research, aiming to combat antibiotic resistance in dermatological applications.

Herbal Treatments: The concept of "herbal medicine," also referred to as "botanical medicine" or "phytomedicine," involves using different plant components, such as berries, seeds, roots, bark, leaves, or flowers, for therapeutic purposes. Historically, herbal medicine has been practiced outside the realm of conventional medicine, but this is evolving due to emerging studies demonstrating its effectiveness in treating and preventing diseases. According to recent estimates by the World Health Organization, approximately 80% of the global population relies on medicinal herbs for certain aspects of their basic healthcare needs [61-65]. Traditional medicine often harbours novel compounds that could aid in the development of chemotherapeutic drugs. The identification of plants used in folk medicine serves as an initial stride toward this objective. Consequently, antimicrobial research endeavours to uncover and formulate innovative antibacterial and antifungal agents. Herbal remedies are often perceived as safer alternatives to synthetic medications, with fewer associated adverse effects. Herbal treatments for skin disorders have gained significant attention due to their potential efficacy and minimal side effects compared to conventional medications. Research indicates that Aloe vera can effectively treat inflammatory skin conditions, such as diaper dermatitis, with fewer side effects compared to traditional treatments like corticosteroids. Additionally, the use of Aloe vera in combination with other herbs, such as chamomile, has shown promising results in enhancing skin healing and reducing irritation.

Moreover, traditional herbal remedies have been documented extensively in various cultures. For instance, the use of *Hibiscus rosa-sinensis* in herbal soaps and oils has been noted for its beneficial effects on skin health, particularly in treating conditions like acne and eczema. The affordability and accessibility of these herbal products contribute to their popularity, especially in regions where conventional medical treatments may be less accessible. Furthermore, the holistic approach of

traditional Chinese medicine (TCM) emphasizes the use of multiple herbs tailored to individual patient needs, showcasing the versatility and adaptability of herbal treatments in dermatology. The integration of these natural remedies into dermatological practice not only aligns with patient preferences for holistic care but also addresses the need for safer treatment options with fewer side effects [66-70].

TABLE 1: LIST OF MEDICINAL PLANTS WITH THEIR PARTS AND USES IN THE TREATMENT OF SKIN DISORDERS

Common name	Botanical name	Part used	Active compounds	Uses
Barbadosaloe	*Aloe vera*	Leaves	Polysaccharides and phenolic compounds	Wound healing burns, Sunburns, wound infections, cuts, dandruff, scabies, insect bites, itching and swelling [71]
Neem	*Azadirachta indica*	Leaves, barks, oil	Azadirachtinandnimbin	Eczema, acne, psoriasis, skin allergies, scabies, boils, vitiligo [72, 73]
Onion	*Alliumcepa*	Bulbs	Apigenin, Quercetin, Diallytrisulphide (DATS), Pyruvicacid	anti-aging, scars, blood circulation, Skin allergy [74]
Greentea	*Camellia sinesis*	Leaves	Polyphenol-epigallocatechin Gallate	Skin cancer, tumors, anti-aging [75]
Licorice	*Glycyrrhiza glabra*	Root	Glabridin, Liquiritin	Atopicdermatitis, Depigmentation, anti-inflammatory, Allergic Dermatitis [76]
Papaya	*Carica papapya*	Seeds, Roots, Pulp, Bark, Peels	Papain, myrosin, alkaloids, rutin, resin, tannins, carpaine, dehydrocarpaine	Eczema, warts [77]
Saffron	*Crocus sativus*	Entire plant	Crocin, picrococin, safranal	Skin cancer, psoriasis, erythema [78]
Turmeric	*Curcuma longa*	Rhizome	*Curcumin*	Acne, alopecia, atopic dermatitis, facial photoaging and psoriasis [79]
Indian gooseberry	*Embillica officinalis*	Fruit	Tannic acid, Gallic acid, Emblicanin A and B	Scabies and reducing itching, skin infections, reducing wrinkles, treating warts, preventing premature aging [80]
Tasmanianblu egum	*Eucalyptus globulus*	Leaves	Trichlosan	Fungal infection, skin problems, wound healing [81]
Ginger	*Zingiber officinalis*	Root and Rhizomes	Gingerol	Tumor suppression, Wound healing [82]
Peppermint oil	*Menta piperata*	Seeds	Menthol	Treats dandruff, Antimicrobial [83, 84]
Carrot oil	*Daudusca rota*	Seeds	Carotene, Vitamin A	Maintains skin tone, anti-wrinkle, rashes, dermatitis [85]

Novel Pharmaceutical Approaches: Traditional pharmaceutical products like powders and creams typically exhibit limited ability to be absorbed through the skin. Standard cosmetics often lack efficacy when used as cosmeceuticals. Herbal remedies have been utilized since ancient times due to their potential effectiveness and minimal side effects. However, researchers encounter challenges in identifying, processing, standardizing, and extracting herbal medicines to develop new formulations. Traditional methods of delivering herbal drugs result in reduced efficacy and poor absorption through the skin. To address these issues, various innovative drug delivery systems (NDDS) have emerged, including ethosomes, phytosomes, transfersomes, nanoparticles, herbal transdermal patches, and biphasic emulsions. Implementing these novel approaches enhances the efficacy, efficiency, and safety of herbal medicines. These techniques offer sustained release, improved patient compliance, and targeted delivery of plant extracts and actives.

Advancements in nanotechnology present significant potential for enhancing the efficacy of poorly soluble or absorbed medicaments, as well as stabilizing unstable herbal extracts or phytochemicals. Ongoing research focuses on developing new approaches to enhance both the appearance and performance of cosmetic products, including liposomes, phytosomes, transferosomes, nanoemulsions, nanoparticles, and microemulsions [86-90].

Liposomes: Liposomes are spherical vesicles characterized by an aqueous core surrounded by a lipid bilayer membrane, primarily composed of natural and synthetic phospholipids. The widespread adoption of liposomes is attributed to their capacity to carry both water-soluble and lipid-soluble components, their adaptable nature, and the diverse range of potential applications they offer. Recent research highlights the efficacy of liposomal formulations in treating skin disorders. An elastic liposomal formulation could effectively deliver RNA interference (RNAi) agents topically for the treatment of psoriasis, showcasing the potential of liposomes to enhance drug delivery through the skin barrier due to their deformability and flexibility. Similarly, liposomal formulations of cyclosporine showed significant promise in treating mild to moderate stable plaque psoriasis, emphasizing the ability of liposomes to improve drug permeation and sustain drug release in the epidermis and dermis. This sustained release is critical for maintaining therapeutic levels of the drug at the site of action, thereby enhancing treatment outcomes [91].

Phytosomes: "Phyto" refers to plants, and "some" suggests a covering or structure. Phytosomes are small cell-like structures typically formed by combining one or two moles of polyphenolic phytoconstituents with phospholipids, usually in ratios of 1:1 or 1:2. The utilization of phytosomes allows for improved rates and extents of lipophilic herbal constituents crossing lipid membranes, highlighting their role as carriers. Additionally, phytosomes can safeguard acid- labile herbal drugs within the gastrointestinal tract. This technology, recently developed and patented, involves incorporating water-soluble phytoconstituents or standardized plant extracts into phospholipids, yielding lipid-compatible molecular complexes [92-93]. Many bioactive components of phytomedicine are water-soluble compounds, such as flavonoids and glycosides. Flavonoids, a significant class of bioactive compounds, exhibit diverse therapeutic properties. Several plant flavonoids, including glycyrrhizic acid and silymarin, possess both medicinal and cosmetic value when applied topically. Plant flavonoids exert localized effects on various conditions like inflammation, edema, pain, and fungal infections [94-95].

Transferosomes: Transferosomes are vesicles resembling sacs, comprised of phospholipids, which serve as promising carriers for drug delivery *via* the transdermal route. They address the challenge of penetrating the stratum corneum, the outermost layer of the skin. Their flexibility enables them to navigate through the pores of the skin. Utilizing transferosomes for colchicine delivery offers site-specific delivery, sustained, and localized, thereby mitigating gastrointestinal side effects associated with oral administration. The unique composition of transferosomes, which includes phospholipids, surfactants, and sometimes cholesterol, allows them to be more deformable than traditional liposomes, thereby facilitating deeper penetration into the skin layers. This property is particularly beneficial for delivering both hydrophilic and lipophilic drugs, making transferosomes versatile carriers for a wide range of therapeutic agents. The mechanism by which transferosomes enhance drug delivery involves their ability to disrupt the stratum corneum, the outermost layer of the skin.

This disruption is achieved through the action of edge activators, which increase the solubility of hydrophobic drugs and improve the overall entrapment efficiency of the drug within the vesicles. Studies have shown that transferosomes can effectively penetrate the skin barrier and release their payload in a controlled manner, which is essential for treating chronic skin conditions such as psoriasis and eczema. The flexibility of transferosomes allows them to adapt to the skin's surface, enhancing their affinity and promoting better drug absorption. Recent research has highlighted the potential of transferosomes in treating specific skin disorders. For instance, transferosome formulations have been developed for antifungal treatments, such as itraconazole-

loaded transferosomes that demonstrated enhanced antifungal activity when incorporated into hydrogels. Similarly, lidocaine-loaded transfero-somes have been shown to improve skin permeation, providing an effective alternative to traditional local anaesthetic injections. These findings underscore the efficacy of transferosomes in delivering therapeutic agents directly to the affected areas of the skin, thereby improving treatment outcomes. Moreover, transferosomes have been explored for their application in treating skin cancer. The ability of these nanocarriers to penetrate deeper skin layers allows for localized treatment of malignant cells while minimizing systemic exposure and potential side effects. For example, studies have demonstrated the effectiveness of paclitaxel-loaded transferosomes in targeting cutaneous metastases from nonmelanoma cancers, showcasing their potential as a novel approach in oncology.

This targeted delivery system not only enhances the therapeutic efficacy but also reduces the toxicity associated with conventional chemotherapy. In addition to their application in cancer therapy, transferosomes are also being investigated for their role in managing inflammatory skin diseases. The use of transferosomes in delivering anti-inflammatory agents has shown promise in reducing symptoms associated with conditions like atopic dermatitis and psoriasis.

By facilitating deeper penetration of these agents, transferosomes can help alleviate inflammation and promote skin healing more effectively than traditional topical formulations. This level of control over drug release can significantly improve treatment outcomes and patient compliance. Furthermore, the safety profile of transferosomes is an important consideration in their development and application. Studies have indicated that transferosome formulations are generally well-tolerated, with minimal irritation reported in clinical settings. This is crucial for patients with sensitive skin or those suffering from chronic skin conditions, as traditional therapies often come with a risk of adverse effects. The biocompatibility of transferosomes, combined with their ability to enhance drug delivery, positions them as a promising option for treating a variety of skin disorders [96].

Ethosomes: Ethosomes are sac-like structures consisting of a high concentration of ethanol and phospholipids. They are efficient in delivering molecules through the skin and into the systemic circulation. Ethosomes have emerged as a promising delivery system for treating various skin disorders due to their unique composition and enhanced permeation capabilities. Ethosomes are soft, malleable vesicles composed primarily of phospholipids, ethanol, and water, which allow them to penetrate the skin more effectively than traditional liposomes. The incorporation of ethanol into the ethosomal structure not only increases the fluidity of the vesicles but also disrupts the ordered structure of the stratum corneum, facilitating deeper penetration into the skin layers. This characteristic is particularly beneficial for delivering therapeutic agents to target skin conditions such as acne, psoriasis, and skin cancer [97].

Nanoparticles: Nanoparticles typically range in size from 1 to 100 nanometers and are comprised of semi- synthetic or synthetic polymers with sub-nano-sized or nano-sized structures. In the realm of nanotechnology, a small object utilized as a complete unit for transport is referred to as a particle.

Nanoparticles offer an efficient means for delivering formulations to the desired site as they can easily encapsulate the formulation. Microencapsulation of herbal extracts within nanoparticles is an effective strategy employed to safeguard drugs against deterioration, volatile losses, or interactions with any other ingredients. Nanoparticles offer various advantages, including enhancement of efficacy, solubility, and bioavailability, improved absorption of herbal medicines, and as well as dose reduction. Nanoparticles have emerged as a transformative technology in the treatment of skin disorders, offering innovative solutions for drug delivery and therapeutic efficacy. Their unique physical and chemical properties enable them to penetrate the skin barrier more effectively than traditional formulations, thus enhancing the bioavailability of active compounds. This capability is particularly significant in dermatology, where achieving localized treatment while minimizing systemic

exposure is crucial for patient safety and therapeutic success [98-99].

Microemulsions: Microemulsions are oil-in-water (O/W) type emulsions characterized by their small size, typically ranging in the size of several microns. They find utility in veterinary applications due to their non-toxic and non-irritating nature. The drug is contained within the inner phase of the microemulsion, facilitating prolonged release through direct contact with tissues. One of the significant advantages of microemulsions is their ability to enhance the delivery of active pharmaceutical ingredients (APIs) that are otherwise poorly soluble or have low bioavailability.

For instance, studies have demonstrated that microemulsions can significantly improve the skin delivery of drugs such as propranolol and celecoxib, leading to enhanced therapeutic effects. The incorporation of penetration enhancers within microemulsions further augments their efficacy by modifying the lipid structure of the stratum corneum, thereby increasing drug permeation. This is particularly relevant in the treatment of chronic skin conditions like psoriasis, where effective drug delivery can substantially improve patient outcomes [100-102].

CONCLUSION: The pharmacological properties of herbal treatments are often attributed to their active compounds, which exhibit antimicrobial, anti-inflammatory, and wound-healing effects. The integration of herbal remedies into the treatment of skin diseases presents a promising avenue for both traditional and modern medicine. The growing body of evidence supporting the efficacy and safety of these treatments underscores their potential as viable alternatives to conventional therapies. As research continues to validate the use of herbal medicines, it is essential to promote their responsible use, ensuring that patients have access to safe and effective treatment options for skin ailments. The growing popularity of herbal phytomedicines is due to their cost-effectiveness, minimal side effects, and natural availability. In response to the needs of a rising global population and declining health, nature offers essential medicines crucial for human survival. The promising results from these natural remedies encourage the exploration of new, potent targets for the herbal industry, which works alongside the pharmaceutical sector for health care advancement.

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