

A Review of Nano-Herbal Formulations: A Futuristic Approach in Herbal Drug Delivery

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Abstract—Nanotechnology's integration into herbal medicine enhances drug delivery, improving therapeutic efficacy and phytoconstituents. Traditional herbal medicines' limitations in bioavailability, stability, and delivery are addressed by nanotechnology, which uses nanocarriers like nanoparticles, nanocapsules, nano emulsions, and nanogels to boost the solubility and absorption of bioactive components. Surface modifications enable targeted delivery, minimizing side effects and allowing controlled release for sustained therapeutic effects with reducing dosing. Nano formulations exhibit potential in anti-oxidants, anti-inflammatory, anti-microbial, and anti-cancer effects. Despite advancements, challenges remain in scalability, regulation, and long-term safety. Future research should focus on standardized manufacturing, safety assessment, and therapeutic uses of nano-formulated herbal drugs to optimize treatment efficacy and advance evidence-based herbal medicine.

Keywords— Nano herbal formulation, Nanotechnology, Nanocarriers, Nano capsules, Nanogels, Curcumin, Aloe vera.

I. INTRODUCTION

Nano technology, a field focused on a design and application of devices and materials at a nano scale, one billionth of a meter has experienced significant advancement and rapid expansion. The term “nano” comes from the Greek word for “dwarf”. A nanometer is a measurement equal to one billionth of a meter. One nanometer is approximately the size of 6 carbon atoms or 10 water molecules. To provide context, a nanometer is much smaller than the diameter of a red blood cell, which measures approximately 7000 nm^[1].

Herbal medicines, favorite for their perceived effectiveness and lower cost compared to the conventional treatments, are gaining global popularity^[2]. However, many active compounds in these medicines have limitation, such as slow absorption, to a targeting, and instability in certain environment. Making the therapeutic application challenging. Herbal medicine contain ingredient that work together to treat diseases. To improve patient adherence and reduce the need for frequent reasons, a gradual and systemic approach to drug delivery is necessary requiring innovative methods^[3].

▪ Nanoformulations:

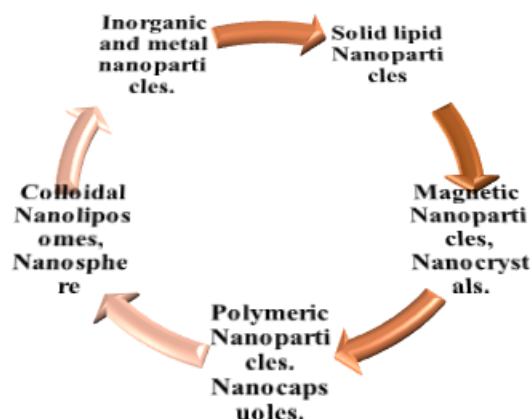
Nanoparticles, though small, possessed diverse physical and chemical properties, allowing them to function effectively without harming other organs and to deliver medication directly to the target site. Nano formulation enhances drug delivery selectivity, safety, and effectiveness for herbal or natural drugs, improving patient compliance and reduce dosage^[4]. These formulations enable drug to reach target tissue and circulate in the bloodstream, making them ideal for nanoparticulate system. Herbal medications can target various organs, including the gastrointestinal tract, liver, brain, kidneys and lungs. Unlike the allopathic system, which addresses multiple ailments, simultaneously, herbal remedies contain numerous constituents. Incorporating herbal drugs into drug delivery

systems enhance their pharmacological activity, stability, solubility, and distribution within tissues, while protecting against toxicity, ensuring sustain delivery and preventing degradation. The poor water solubility of most herbal medications, due to their hydrophobic nature, leads to increased systemic clearance, necessitating higher repeated doses, which limits their clinical use^[5]. Nanoparticles improve the solubility of herbal and help localize medication combine enhancing patient compliance and efficacy. Limitations of herbal extract, such as liver metabolism and pH instability, can lower blood drug level below therapeutic concentration, releases effectiveness. Nanoparticles are considered of crucial drug delivery system, and maintaining a consistency chemical profile, biological activity, and quality assurance program is essential. Nano particles have found application in the treatment of various chronic condition, including inflammatory diseases, cancer, Alzheimer disease, diabetes, colitis and as anti-microbial, anti-arthritis, anti-analgesic antioxidants and antifungal agents. Nanoparticle exhibit enhances bioavailability, leading to improved eco-soluble stock. Consequently, the extent the duration at drug remains active in the body. Additionally, nanoparticle facilitate target drug delivery^[6].

▪ Herbal Nanoparticle Formulations and Their Benefits:

Herbal nanoparticle formulation offer benefit in the pharmaceutical industry, particularly in drug delivery. Different types of herbal nanoparticles are used to improve efficacy and uptake by modifying drug formulation, considering factor like degradation mechanism, drug delivery system, drug stability and regulatory standard. Nanoparticles can reduce drug toxicity while maintaining therapeutic effect, improving drug distribution in the blood and enhancing nanoparticle retention and permeation across the blood brain barrier^[7].

▪ Types of nanopharmaceuticals:


Fig 1: Types of Nano Pharmaceuticals^[8].

▪ Nanocarriers:

Nanocarriers are defined as objects with at least one dimension in 1 to 100 nm scale. Nanotechnology-based strategies are utilised in the treatment of neurological disorders, particularly in drug formulation, because of many drugs cannot naturally cross the blood-brain barrier^[8]

▪ Types of nanocarriers:

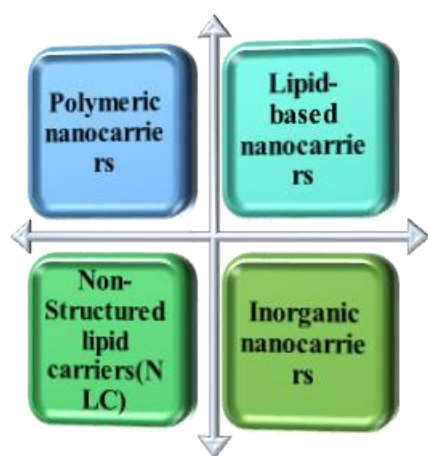


Fig 2: Types of nanocarriers.

- Polymeric nanocarriers: Includes dendrimers, nanogels, polymer-drug conjugates, micelles, and polymeric nanoparticles. They have potential applications in biotechnology, such as targeted drug delivery, gene and drug carriers, and magnetic separation^[9].
- Lipid-based nanocarriers: Lipid-based nanocarriers are favored for their high quality, flexibility, and biocompatibility and are used by pharmaceutical researchers to deliver drugs in the bloodstream. Include lipid paste and polymeric structure like nano emulsions, liposomes, dendrimers, and carbon nanotubes^[10].
- Non-structured lipid carriers (NLC): Nanostructured lipid carriers (NLCs) represent a second generation lipid

nanoparticle system that combines both solid and liquid lipids, advancing from solid lipid nanoparticles (SLNs). Solid lipid used in include hydrogenated palm oil (HPO), Glycerol monostearate, steric acid, and cetyl alcohol^[11].

- Inorganic nanocarriers: Inorganic nanocarriers result from Metallic complexes, such as iron-oxide and NPs, gold and NPs and zinc and NPs and are used in a drug for lipid nano conditions, improving diagnostic and nano formulations. Includes Quantum dots, Metal Nanoparticles^[10,11].

Benefits of nano herbal formulations:

- Nano herbal formulation offers significant advantage for poorly soluble and bioavailable helper medicine by enhancing their absorption and delivery into the bloodstream.
- Noble pharmaceutical carriers like polymeric improve the solubility of active agent making them more effective in cancer treatment^[12].
- Plant based nanoparticles with their antimicrobial and antioxidant properties enhanced preservation, packaging, and nutrient delivery in food industry thereby improving product stability and safety^[13].

▪ Herbal Nanosuspensions:

Herbal nano suspensions are liquid mixture containing tiny, solid particles stabilized by surfactants or polymers these mixture help herbal extract dissolve faster and get absorbed by the body more effectively especially when the extract don't dissolve easily or get absorbed well on there on^[14]. Various methods, including nano precipitation anti-solvent precipitation, and high pressure homogenization an create these nanosuspensions these method reduce the particles size in herbal extract combine increasing the surface area and improve their dissolution rate ultimately enhancing the bodies ability to absorb the extract^[15].

▪ Nano-polymerisation in herbal medicine:

Nano polymerization in herbal medicine employs precise technology to improve the bioavailability and bioactivity of herbal compounds, enhancing the efficacy of plant extracts through encapsulation, or by absorbing them in a nano size system composed of a biodegradable and biocompatible products^[16]. This method reduces dosage requirement, minimizes side effect, and enhances overall activity^[17].

▪ Herbal nanofibers:

Herbal and fiber preparation in waste technique like electro spinning, bubble electro spinning fibers from plant extract. These nanofibers can enhance the solubility and viable ability of herbal active components, reducing negative effects^[18].

▪ Herbal nano emulsion:

Nano emulsions present considerable advantages for the efficient delivery of herbal extracts across diverse applications. They can be synthesized using a variety of methods, encompassing both low-energy and high-energy emulsification techniques^[19].

Nano emulsions are essential for encapsulating active compounds, thereby improving their bioavailability and safeguarding them from degradation. In conclusion, the development of herbal nano emulsions offers promising opportunities for improving the delivery and efficacy of herbal extracts in various fields ^[20].

Various emulsification methods:

- Nano emulsification of herbal extracts via solvent evaporation method^[21].

- Nano emulsification of herbal extracts through homogenization^[22].

Conventional Limitations of Herbal Medicines and Nano Herbal Formulations:

S.no	Conventional Limitations	Herbal Medicines and examples	Nanoherbal Formulation (Advantages)	Reference
1	Safety	Potential toxicity, adverse effect. (Eg: <i>Garlic</i>)	Reduced toxicity, controlled dosing (Reduced Toxicity)	23,24
2	Regulation and quality control	Poor regulation, adulteration, contamination (Eg: <i>Ashwagandha</i> (<i>Withania somnifera</i>))	Better standardization and quality control (Nano formulations improve solubility and absorption. - Enhance bioavailability of withanolides. - Potential for targeted delivery and reduced side effects.)	25
3	Drug interactions	Risk of harmful interactions (Eg: <i>Warfarin</i>)	Potential for targeted delivery minimizing interactions (Nanoformulation enables controlled and targeted release of warfarin, potentially minimizing systemic exposure).	27
4	Bioavailability	Often poor and variable. (Eg: <i>Berberine</i> (from <i>Berberis vulgaris</i>))	Enhanced bioavailability and stability. (Formulated in nano-carriers or transferosomes to improve absorption and residence time).	24
5	Scientific evidence	Limited and inconclusive (Eg: <i>St. John's Wort</i> (<i>Hypericum perforatum</i>))	Potential for improved efficacy through better delivery. (Nanoencapsulation enhances absorption, protects flavonoids and terpenoids from degradation, and improves antioxidant and neuroprotective effects).	26

Diseases treated by Herbal drugs:

1. Treatment of skin disorders by herbal drugs:

Skin Disorder:

Skin, the human body's largest and most diverse organ, holds significant for both aesthetic and health reasons. A patient's psychological well-being can be affected by the appearance of skin conditions like dermatitis^[28,29].

Common skin problem:

- Rashes^[30].
- Bacterial infection^[31].
- Fungal infection^[32].
- Pigmentation problems^[33,34].
- Cancers^[35].
- Viral infection^[32].
- Others (Wrinkles, Pimples, Psoriasis, Acne)^[32].

Herbal drugs for skin diseases:

Herbal treatments for second conditions are gaining traction as an alternative approach. The use of synthetic compounds in conventional treatments raises concern about potential skin toxicity with long-term use^[36].

Consequently, there is a growing preference for natural alternatives like plant based medications, health products, food supplements, and cosmetics. This shift is largely driven by the

perception that natural products are safe, have a minimal side effects, and are cost effective^[37].

1. Atopic dermatitis:

Atopic dermatitis, also known as eczema, is a long-lasting inflammatory skin disorder marked by itching^[38].

a. Licorice:

Seiwerth J et al. indicates that licorice, specifically "Glycyrrhiza glabra L" and "Glycyrrhiza uralensis" have anti-inflammatory effects due to elements such as glycyrrhetic acid, triterpenes glycyrrhizin, licochalcone A, and the flavonoid isoliquiritigenin. They effectively reduce inflammation in individual atopic dermatitis^[39].

b. Tormentil and Evening Primrose:

Tormentil and evening primrose have been utilized in dermatology for centuries. Traditionally, dermatologists have applied tannins derived from black tea and oak bark topically as baths or wraps for the treatment of eczema^[40]. Evening primrose oil, rich in gamma- linolenic acid, is beneficial for atopic dermatitis and is used in both topical and internal products. A 48-hour patch test revealed that a cream with 2% tannins from tormentil roots exhibited a vasoconstrictive effect comparable to a corticoid^[41].

Herbal formulation in different forms used for skin diseases:

Name of Plant	Part of plant	Use	Research	Reference
<i>Oryza Sativa</i>	Seeds (Nanofibers)	Antioxidant and anti-inflammatory activity, antibacterial, antifungal effect, psoriasis and anti-aging agents.	Palungwachira et al. evaluated the cellular activity of anthocyanins, on the modulations of type-I collagen Gene expression and the suppression of H ₂ O ₂ induced activation of necrosis factor κB in skin fibroblasts, revealed that anthocyanins from <i>Oryza Sativa</i> possess anti-inflammatory and anti aging properties.	42
<i>Aloe vera</i>	Leaves (Chitin nanogels, Nanostructured lipid carriers (NLCs), and nanoemulsions)	Insect bites, sunburns, wound infections, scabies, round healing, and wound healing.	Padmakar et al. evaluated Do you see a fee and efficacy of topical natural aloe vera in treating stable vitiligo. Deer finding indicated that natural aloe vera was both effective and safe for this purpose. However, they suggested that for the research with larger sample cybers in randomized control, trial is necessary to definitely confirm these	43

			results regarding effectiveness and safety of aloe vera in managing vitiligo.	
<i>Glycyrrhiza glabra</i>	Root (Hydrogels, Liposomes)	Allergic dermatitis, depigmentation, and atopic dermatitis	Jan et al. isolated the anti-oxidant activity isolated different polyphenols from extract of glycyrrhiza glabra and found flavonoids and other compounds.	44
<i>Nicotiana Tabacum</i>	Leaves (Liposomes, Niosomes and Solid lipid nanoparticles)	Antibacterial, antifungal wound healing and anti-apthous Activity.	Shama et al. used a Wistar rat model conducted in vitro and in vivo has showing the high efficacy of ethanolic extract in wound healing suggesting that they could be applied topically as herbal medicine.	45
<i>Punica granatum</i>	Pericarp (Lipid- based nanoparticles)	Anti-melanoma, anti-inflammatory, antibacterial, and wound healing.	Saini et al. investigated the use of Punica granatum (pomegranate) Field extract against multi drug resistance bacteria. The study focuses strong antibacterial activity when the extract interacted with the bacteria, showing a minimum inhibitory consideration ranging from 780 to 6250 µg/mL and a zone of inhibition mating. 14-27mm. Additionally, the research assessed the safety and effectiveness of the extract in treating stable vitiligo.	46

• Nano emulsion:

Plant	Approaches	Technique	Types of study	Outcomes	Ref.
Garlic (dialkyl polysulphides) and Ginger (Zingiberene, curcumene, and β-bis bolene)	Nanoemulsion	Ultrasonic cavitation	<ul style="list-style-type: none"> ➤ Droplet size zeta potential. ➤ Refractive index viscosity transmittance. ➤ HPLC. ➤ Antimicrobial studies (in vitro). ➤ Stability Studies. 	<ul style="list-style-type: none"> ✓ Quick recovery, with 86% to 100% of the wound healed in just 10 days. ✓ Showed anti-inflammatory activity ✓ Enhanced Wound healing potential and promoted fast epithelization 	47
Alpinia galanga extract (1-acetoxychavicol acetate)	Nanoemulsion	Ultrasonic homogenization method.	<ul style="list-style-type: none"> ➤ Droplet size ➤ Polydispersity index ➤ Zeta potential ➤ PH ➤ Transmission electron microscopy 	<ul style="list-style-type: none"> ✓ Proven anti-inflammatory activity ✓ Controlled release ✓ Increased nanoemulsion viscosity and adhesiveness ✓ Myeloperoxidase activity and interleukins content 	48
Aniba canelilla (Kunth) (1-nitro-2-phenylethane and methyleugenol)	Nanoemulsion	Ultrasonic homogenization method.	<ul style="list-style-type: none"> ➤ Skin disorders 	<ul style="list-style-type: none"> ✓ Droplet size ✓ Polydispersity index ✓ Zeta potential ✓ PH ✓ Transmission electron microscopy ✓ Release studies ✓ Skin permeation essays 	49
Chromolaena odorata (flavanoids, tannins)	Oil-in-water emulsion Pluronic micelles	Oil-in-water emulsion Pluronic micelles	<ul style="list-style-type: none"> ✓ Burn wound healing 	<ul style="list-style-type: none"> ✓ Organoleptic properties ✓ In vitro release study ✓ Stability studies 	50

• Nanofibers:

Plants	Approaches	Techniques	Skin Disease	Types of study	Outcomes	Ref
Malva sylvestris (mucilage and flavonoids)	Nanofibers	Maceration method	Wound dressings	<ul style="list-style-type: none"> ➤ In vivo wound Healing. ➤ Assessment of swelling ratio. ➤ Histomorphometry Analysis. ➤ Statistical analysis. 	<ul style="list-style-type: none"> ✓ Improve the absorption ability of wound exudates. ✓ Antibacterial activity ✓ Effective at reducing Both acute and long-term Inflammations. 	51
Ananas comosus (bromelain)	Nanofiber	Electrospinning method	Wound healing	<ul style="list-style-type: none"> ➤ In vitro release study ➤ Enzymatic activity of bromelain ➤ Swelling test ➤ Loading analysis ➤ Cytotoxicity test ➤ In vivo studies 	<ul style="list-style-type: none"> ✓ Burn wound repair. ✓ Burn healing effect. ✓ Induced burn wounds in rats. ✓ Exhibited reduced cytotoxicity and improved physicochemical characteristics and release profile. 	52

• Nanogels:

- Herbal nano formulations for skin diseases:

Plants	Approaches	Techniques	Skin Disease	Types of Study	Outcomes	Ref.
<i>Sesame oil</i> (lignans and sesamol)	Hydrogel.	Diffusion Technique.	Skin acne and skin cancer.	<ul style="list-style-type: none"> ➤ Microbiological study. ➤ UV spectroscopy ➤ FTIR SEM. 	<ul style="list-style-type: none"> ✓ Showed antioxidant ✓ And anticancer activity. ✓ Treatment of skin cancer and acne. ✓ Synergistic action of the flower extract. ✓ Exhibited strong antibacterial activity. 	53
<i>Smilax china</i> and <i>Salix alba</i> (quercetin)	Nano lipid Carrier based gel	Sonication method	Psoriasis	<ul style="list-style-type: none"> ➤ Particle size ➤ Polydispersity ➤ High entrapment ➤ TEM ➤ Drug release ➤ Dermal transport studies ➤ Thermo-analytical studies ➤ Dermatokinetic study ➤ Skin irritation study 	<ul style="list-style-type: none"> ✓ Showed spherical Vesicles. ✓ Sustained drug release. ✓ Enhanced dermal flux. ✓ Enhanced penetration of drug-loaded NLC gel. ✓ Safer topical administration of herbal medications. 	54
<i>Calotropis procera</i> (flavones, tannins, and alkaloids)	Nanogel	Diffusion technique	Skin acne and skin cancer	<ul style="list-style-type: none"> ➤ Microbiological study ➤ UV spectroscopy ➤ FTIR SEM. 	<ul style="list-style-type: none"> ✓ Showed antioxidant and anticancer activity ✓ Treatment of skin cancer and acne ✓ Synergistic action of the flower extract ✓ Exhibited strong antibacterial activity. 	55

Plants	Approaches	Techniques	Skin disease	Types of study	Outcomes	Reference
<i>Aloe vera</i>	Nanoflowers	Ultrasonic probe	Wound healing	<ul style="list-style-type: none"> ➤ Scanning electron microscopy. ➤ X-ray spectroscopy ➤ Fourier transform infrared spectroscopy ➤ X-ray diffraction. ➤ In vitro wound healing 	<ul style="list-style-type: none"> ✓ Highest peroxidase-mimicking activity. ✓ DPPH assay determined the antioxidant activity. ✓ Showed antimicrobial activity. ✓ Wound healing. ✓ Enhanced biological properties. 	56
<i>Phyllanthus emblica</i> L. (sinapic and ferulic acid)	Topical gel	Rotary Evaporator	Anti-aging	<ul style="list-style-type: none"> ➤ In vitro assays. ➤ Cellular assays. ➤ Statistical analysis. 	<ul style="list-style-type: none"> ✓ Antioxidant, anti-tyrosinase, and anti-melanogenesis. ✓ Anti-skin aging activities. ✓ Improving skin hydration and elasticity, lightening the tone of the skin, and reducing wrinkles. 	57
<i>Azadirachta indica</i>	Nanocapsule	Sonochemical Method	Bacterial diseases	<ul style="list-style-type: none"> ➤ In vitro antibacterial activity. ➤ Bacterial strain. ➤ In vitro antibacterial activity. 	<ul style="list-style-type: none"> ✓ Immunological, anti-inflammatory, and anti-ulcer characteristics. ✓ Antioxidant, antifungal, antibacterial, and antiviral properties. ✓ Improved bioactivity and chemical activity. ✓ High solubility ✓ Effective coating of neem extract. ✓ Maximizing the aquaculture industry. 	58
<i>Berberine</i>	Gel-core oleosomes	Modified ethanol injection technique	Vitiligo	<ul style="list-style-type: none"> ➤ Ex vivo studies ➤ In vivo pharmacodynamic studies. 	<ul style="list-style-type: none"> ✓ Showed antioxidant and anti-inflammatory activity ✓ Sodium hyaluronate and sodium oleate both showed excellent skin penetration ✓ Sustained release of 45% at 24 h ✓ Higher stability ✓ Minimal systemic side effects 	59

■ In the treatment of psoriasis:

Psoriasis is an immune related inflammatory condition with autoimmune characteristics, impacting the skull, skin, lower back, and joints elbows and knees it is a chronic, painful disfiguring non contagious and debilitating this is that can manifest at any age, although it predominantly occurs between the age from 510 and 610^[60]. Globally, at least 100 million people are affected by psoriasis, with the prevalence estimate

ranging from 0.010% to 11.43% making it significant to global health concern, it affects approximately 2% of the world's population^[61].

Psoriasis is a skin condition affecting many individuals, characterized by silver bite scales atop inflamed, red patches, typically found on knees, elbows, naval and lower back. Metabolic issues are associated with this condition^[62].

Psoriasis, mediated by immune stimulation, is a T-cell mediated autoimmune disease characterized by a strong infraction between the innate immune cell (macrophages, DCs, neutrophils), adaptive immune cells (melanocytes,

keratinocytes, and endothelial cells). These interactions contribute to the production of inflammatory mediators^[63].

▪ *Types of psoriasis:*

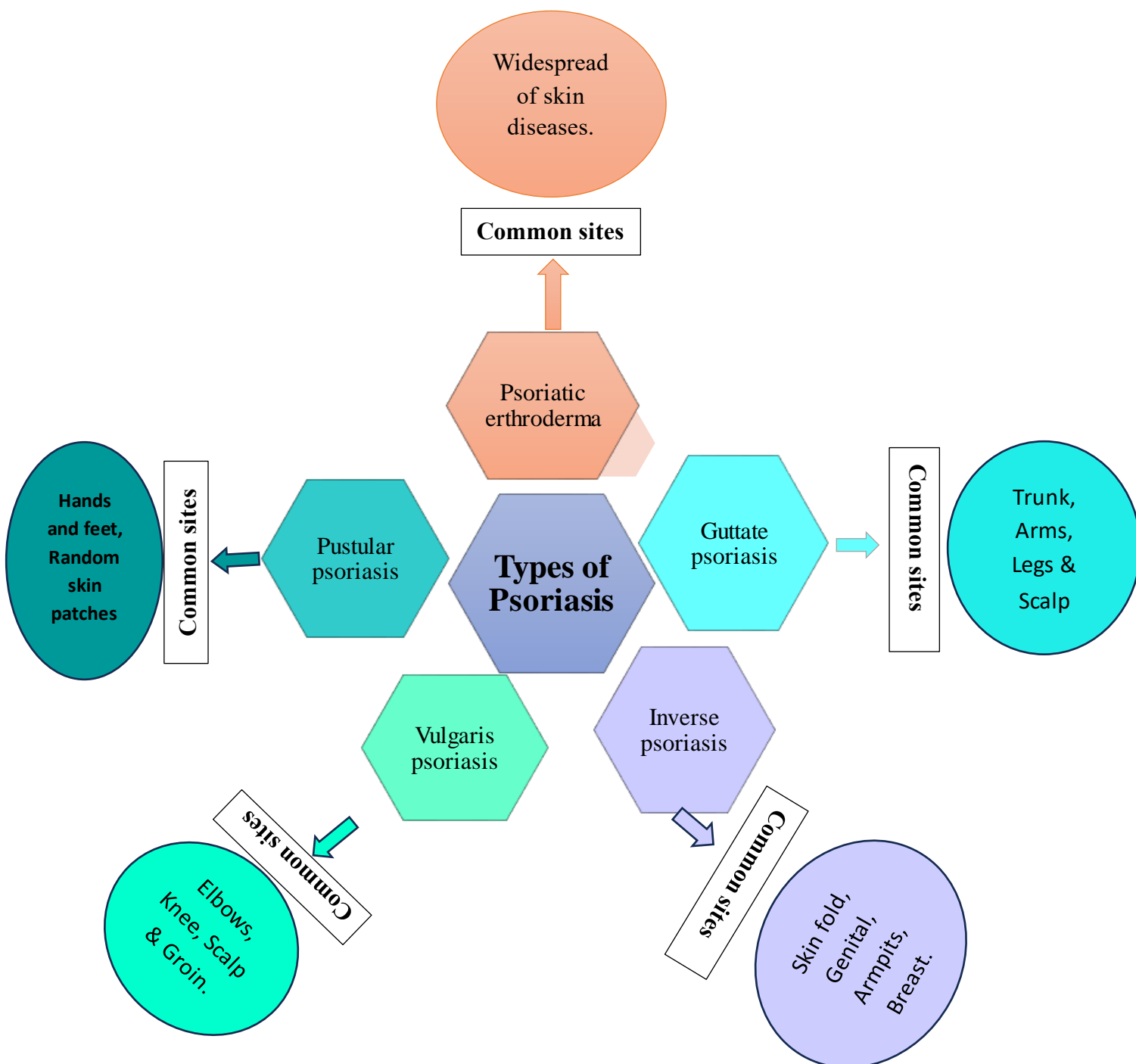


Fig 8: Types of psoriasis.

▪ *Recently available treatments for psoriasis:*

Treatment choices are based on the severity and the location of the psoriasis, as well as any other health conditions present. Practice consider when planning treatment include the body severity index (BSI), contract disorders and psoriatic arthritis^[64]. Common treatment includes local therapies, photo

therapies., immunosuppressants, and other systemic medication^[65].

These treatment are applied based on the specific characteristics of the psoriasis, which can range from mild to severe mild to severe symptoms are often treated with the corticosteroids and vitamin D and the related medication applied directly to the skin^[66].

UVB and UVA phototherapies can be used in the combination with the local treatments to improve result. However, phototherapy is not suitable for the patient with photosensitivity, cataracts, or kidney liver diseases^[67].

▪ *Herbal formulations for the psoriasis treatment:*

Herbal treatments offer a potentially effective approach to managing psoriasis Due to their high efficacy and low toxicity.

Table: Anti psoriatic activity of natural products from plant source

Name of the plant with important characteristics.	Mechanism of Action	Types of drug delivery systems for psoriasis treatment	Reference
<i>Aloe Vera</i> Phytochemical <i>Aloe-emodin, Barbaloin.</i>	✓ The mechanism of action involves inhibiting of specific enzymes related to the cell growth and inflammation. Also red disrupts redox reaction, causing damage to mitochondria and the breaking down of lipids in psoriatic epidermal membrane.	✓ Hydrophilic cream, Barbaloin Gel, Aloe emodin loaded chitin Nanogel, Emulgel	68-69
<i>Curcuma longa</i> Phytochemical <i>Curcumin</i>	✓ The number of disintegrated cell nuclei increases as mitochondria release cytochrome c, leading to the activation of caspase-10 and caspase-8. This process inhibits NF-κB activity, protein kinase B, and extracellular signal-regulated kinases 1/2 (ERK1/2). It also reduces phosphorylation levels of Akt and ERK and decreases the expression of IL-17A, IL-22, IL-17F, IL-6, IL-1, and TNF-α mRNA, along with TNF-α and IFN-γ levels. Conversely, it enhances the production of involve filaggrin in Ha Ca T cells, increases the expression of TRAIL-R1/R2, and suppresses TNF-α-induced IL-6 and IL-8.	✓ Liquid crystalline systems ✓ Liposomal gel ✓ Nanoparticle-incorporated porous collagen patches ✓ Curcumin-loaded hyaluronan-modified ethosomes ✓ Nanostructured lipid carriers (NLC) ✓ Topical gel loaded with nanosponges ✓ Polymeric hydrogel ✓ Nanoemulgel ✓ Cellulose nanofiber (CNF) ✓ Nanogel ✓ Silk fibroin hydrogel combined with polymeric nanoparticles ✓ Nanoemulsion gel ✓ Liposphere gel ✓ Turmeric microemulgel ✓ Curcumin nanoparticles	70-71
<i>Artemisia annua</i> Artemisia capillaries Phytochemical Artesunate, Essential oils.	➤ Inhibit processes related to proliferation, differentiation, apoptosis, immune regulation, and the control of epidermal thickness.	✓ Cream	72-73
<i>Givottia rottleriformis</i> Phytochemical Rutin, Luteolin, Kaempferol.	➤ Block the keratinocyte cell division	✓ Rutin and Gallic Acid Loaded Herbal Gel.	74-75
<i>Boswellia serrate</i> Phytochemical Boswellic acid (KBA or 11-keto-b-boswellic acid) and (AKBA or acetyl-11-keto-b-boswellic acid).	➤ Prevention of leukotrienes production by the inhibition of 5-lipoxygenase (5-LO)	✓ Extract (Bosexil®), cream, Nano Gel.	76-77
<i>Camellia sinensis</i> , Coffea Arabica, Cola acuminata Phytochemical Caffeine	➤ Caffeine reduces the activity of inflammatory pathways and slows the evolution of psoriasis.	✓ Nanosponge loaded topical gel, solid-lipid nanoparticles (SLNPs) and nanostructured lipid carriers (NLCs)	78-79-80
<i>Cannabis sativa</i> Phytochemical Cannabinoids, (Δ10-Tetrahydrocannabinol), cannabidiol, cannabigerol)	➤ Decreased the proliferation of hyper proliferating human keratinocytes (HPV-16 E6/E7 transformed human skin keratinocytes).	✓ Ointment, hydrophilic gel and Transdermal patch	81-82

II. CONCLUSION

Nano herbal formulation represent a promising advancement in the nanoherbal delivery, enhancing the therapeutic potential of natural compounds through improved bioavailability and targeted action. Their application is treating skin disorders. Highlight where effectiveness safety, potential to bridge traditional remedies with modern nanotechnology. Continued research Will further establish their role in future dermatological therapies.

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