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Review Article

Planterosomal Gel Designed by Different Polyherbal Herbs: A Novel Method for Skin Healing

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ABSTRACT

Skin healing is complex and involves a wide range of cellular and molecular interactions. Because they include a wide variety of bioactive components, traditional herbal treatments have long been acknowledged for their ability to aid in the healing of wounds. In this work, we present a unique method of creating a planterosomal gel to utilize the medicinal qualities of polyherbal plants. Plant extract-derived planterosomes provide a viable platform for improving herbal medicines' bioavailability and therapeutic effectiveness. Our goal was to develop a formulation that would enable the targeted delivery of bioactive ingredients to the site of damage and prolonged release of those constituents by encasing a synergistic combination of polyherbal extracts inside a gel matrix. Medicinal plants that are well-known for their ability to cure wounds were extracted for the formulation process. These herbs include Centella Asiatica, Calendula officinalis, and Aloe vera. After that, a specific method was used to encapsulate these herbal extracts into planterosomes, maintaining their stability and bioactivity. The effective encapsulation of herbal extracts within the planterosomal framework, with a homogeneous particle size distribution and desired physicochemical characteristics, was validated by characterization tests. Moreover, investigations conducted in vitro showed sustained release kinetics, suggesting the possibility of long-lasting therapeutic benefits. Animal models with skin wounds were used in in vivo research to assess the planterosomal gel's effectiveness. Improved collagen deposition, decreased inflammation, and increased re-epithelialization showed that the polyherbal planterosomal gel treatment greatly sped up the healing process as compared to control groups. Using a combination of controlled release and targeted administration methods, this formulation maximizes the benefits of many herbal constituents working together to provide a potentially effective treatment for a range of dermatological diseases and wound care applications. The therapeutic effectiveness and safety of this novel formulation in human patients should be investigated further.

Introduction

A planterosomal gel formulation usually captures the fundamental ideas and goals that drove the creation of this novel drug or cosmetic delivery technology. A planterosomal gel combines plant-derived phospholipids' advantages with a gel matrix's adaptability to provide a state-of-the-art solution to medicine administration and skincare technologies. The statement establishes the framework for more study, development, and optimization by outlining this formulation's reasoning, objectives, and possible uses (*Rathore, et al. 2012)*.

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In the pharmaceutical and cosmetic sciences realm, the quest for efficacious and versatile delivery systems is ceaseless. The novel incorporation of phospholipids produced from plants into a gel matrix, which gave rise to the idea of planterosomal gels, is at the forefront of this endeavor. The creation of planterosomal gels, which are based on the ideas of biocompatibility, sustainability, and increased therapeutic or cosmetic efficacy, marks a paradigm change in the architecture of delivery systems (*Singh, et al. 2011)*.

Utilizing the special qualities of phospholipids isolated from plant sources, such as soybean, sunflower, or lecithin, to effectively encapsulate and transport bioactive chemicals is the main goal driving the development of planterosomal gels. Because of their biocompatibility and capacity to resemble biological membranes, these phospholipids provide an excellent platform for the encapsulation, defenses, and controlled release of active substances. The goal of planterosomal gels is to improve the stability, bioavailability, and therapeutic or cosmetic effect of encapsulated substances by using the natural biophysical characteristics of phospholipids (*Vangapelli, et al. 2011)*.

Furthermore, the planterosomal delivery method gains a further degree of adaptability and effectiveness from the gel matrix. The planterosomal vesicles are carried by the gel scaffold, which also has variable rheological qualities that make application easier, skin penetration better, and release kinetics longer. The synergistic combination of gel matrix and plant-derived phospholipids offers new avenues for the creation of sophisticated formulations for a range of medical and cosmetic uses (*Saha, et al. 2013)*.

From pharmaceutical formulations for transdermal medication administration to cosmetic solutions addressing particular dermatological conditions, planterosomal gels have a wide range of possible uses. Within the pharmaceutical industry, planterosomal gels have the potential to administer a broad range of therapeutic agents with enhanced patient compliance, safety, and efficacy, such as peptides, small compounds, and nucleic acids. Similar to this, these gels provide a sophisticated framework for the encapsulation of vitamins, antioxidants, and bioactive plant extracts in the context of cosmetics, facilitating increased skin penetration and precise distribution for the best possible renewal and nutrition (*Kidd 2009)*.

As we set out to create planterosomal gels, we are driven by a dedication to efficacy, sustainability, and creativity. We want to fully use this innovative delivery method by doing thorough research, refining the formulation, and assessing its effectiveness. In the end, we hope to turn scientific discoveries into practical advantages for people all over the world who use skincare and healthcare products (*Yanyu, et al. 2005)*.

A new era in delivery system design has begun with the invention of planterosomal gels, whereby contemporary gel technology and phospholipids inspired by nature have combined to alter the parameters of functioning and efficacy. We work to fulfill the potential of planterosomal gels as the foundation of the next pharmaceutical and cosmetic formulations, with an unwavering focus on scientific quality and translational effect (*Saroha, et al. 2024)*.

The incorporation of polyherbal herbs into a planterosomal gel signals a paradigm shift in the treatment and recovery of the skin. Through the utilization of nature's abundant advantages combined with an advanced planterosomal delivery technology, we set out to effectively and skilfully restore damaged skin (*Joshi, et al. 2019)*.

We welcome a new age in skincare innovation as we bid adieu to traditional techniques: one in which the accuracy of contemporary pharmaceutical science combines with the restorative power of polyherbal therapies. Our dedication to quality motivates us to investigate the endless potential of polyherbal remedies, combining the vast knowledge of conventional herbal therapy with the most recent scientific discoveries (*Vishal, et al. 2011)*.

Preparation of Planterosomal Gels

Planterosomes are formed when a stoichiometric amount of phytoconstituents and phospholipids react and form a polar bond in the presence of an aprotic solvent ratio for producing planterosomes is 1:1. In general, three techniques are used to prepare planterosomes: antisolvent precipitation, rotary evaporation, and solvent evaporation, which are briefly explained below (*Jain 2005)*.

Antisolvent Precipitation Method

In a spherical bottom flask containing an organic solvent, place a specific amount of phospholipid and an extractive part of the plant and reflux the mixture for 2 hours at 60 degrees Celsius. Concentrate the mixture to 5ml, and then add the n-hexane while continue stirring to achieve precipitation. Precipitation is collected in a desiccator. Example: - Jeevana J. B. et colleagues created Naringin phytosomes using an antisolvent precipitation and rotary evaporation process in various ratios (*Bhatt, et al. 2023)*.

Rotary Evaporation Method

In a rotating spherical bottom flask containing an organic solvent, place a particular amount of phospholipid and an extractive portion of the plant and reflux the combination for 3 hours at a temperature not exceeding 40 degrees Celsius. Thin films are formed via the hydration of nhexane with continuous stirring. The precipitate is collected for future research. Example:- Nesalin et al prepared and evaluated the curcumin phytosome by rotary evaporation method in five different rations (*Franco, et al. 1998)*.

Solvent Evaporation Method

In a flask, combine the phytoconstituents and phospholipid with an organic solvent and reflux for 2 hours at 40 degrees Celsius. To obtain the precipitate, concentrate the mixture to 5-10ml by adding n-hexane. Collect the precipitate complex for further investigation. Example: - Telange et al. use solvent evaporation to create the Mangiferin-phospholipid complex (MPLC). Another example is Udapurkar et al. (2018), who manufacture Citrus phytosome (CP) by refluxing followed by solvent evaporation in various phosphatidylcholine to citrus limon extract ratios of 0.5:1, 0.75:1, 1:1, 2.5:1, and 3:1 (*Dayan, et al. 2002)*.

Other Preparation Method

The Planterosome of G. lucidum was prepared by reacting the herbal extracts with different ratios of soya lecithin and cholesterol by using the thin-film hydration method. Different batches of gels were prepared by the optimized formulation of G. lucidum planterosome. For the preparation of gel, different ratios of Carbopol 940 and HPMC were dispersed in planterosomal suspension. This solution was continuously stirred at 500 rpm for 30 min to get the planterosomal gel as shown in Fig. 1. Propylparaben (0.1%) was used as a preservative (*Facino, et al. 1994)*.

Properties of Planterosomal

The physical size, membrane permeability, chemical makeup, percentage of entrapped solutes, and purity and quality of the starting materials are some of the variables that control planterosome activity in both biological and physical systems. Thus, physical characteristics such as form, size, dispersion, percentage of drug capture, entrapment volume, percentage of drug released, and chemical composition are used to describe planterosomes.

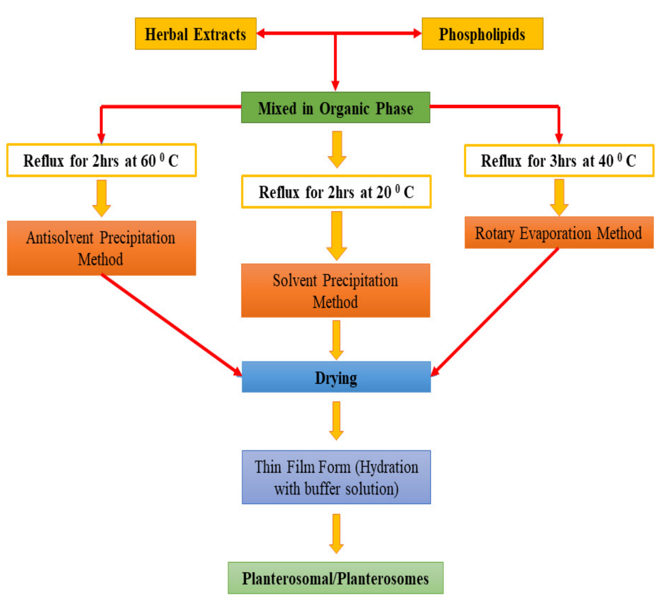

Fig. 1: Different preparation methods for planterosomal/ planterosomes (Semalty, *et al.* 2006)

Chemical Properties

- A complex between a soy phospholipid (natural phospholipid) and a natural product is called a planterosome.
- In an appropriate solvent, by reacting stoichiometric amounts of phospholipids and the substrate, this complex is obtained.
- The primary phospholipid substrate interaction, as determined by spectroscopic data, results from the hydrogen bonding of the polar functionalities of the substrate—phosphate, and ammonia groups—with the polar head of the phospholipids (*Bombardelli, et al. 1989)*.
- Planterosomes assume a shape like that of a micelle forming a liposomal-like structure, when treated with water.
- The active principle in liposomes dissolves in the internal pocket or floats in the layered membrane, but in planterosomes, the active principle anchors to the polar head of phospholipids and forms an integral component of the membrane (*Bombardelli 1991)*.
- In the catechindistearoylphosphatidylcholine complex, for instance, the phenolic hydroxyls of the flavone moiety and the phosphate ion on the phosphatidylcholine side create a hydrogen bond. This can be inferred by comparing the complex's NMR with those of pure predecessors.
- A shift is signaled by the fatty chain.
- This suggests that the active principle is encircled by the two lengthy aliphatic chains. This forms a lipophilic sheath that protects the catechin and the phospholipid's polar head (*Yanyu, et al. 2005)*.

Biological Properties

- In comparison with conventional herbal extracts, planterosomes which are advanced forms of herbal products, are better absorbed, and utilized thereby producing better results.
- It has been shown via pharmacokinetic and pharmacodynamic investigations conducted in both human and animal subjects that planterosomes have a higher bioavailability than non-complex botanical compounds (*Jain 2005)*.

Benefits and Limitations

Planterosomal gels have intriguing prospects in medicinal and cosmetic applications. This innovative formulation combines the benefits of plant-derived nanoparticles (planterosomes) with the adaptability of gel-based delivery methods (*Maghraby, et al. 2000)*.

- The drug's bioavailability is improved.
- Planterosomes confirm medication delivery to the tissue of interest.
- It improves medication penetration for transdermal and dermal administration methods.

- Because of its superior penetration capability, it is preferable to liposomes in beauty products.
- Phosphatidylcholine is employed as a carrier in phytosomes, and it also has a hepatoprotective effect.
- Because phosphatidylcholine is essential to cell membranes, it nourishes the skin.
- The dosage requirement is low because phytosome aids in the absorption of phytoconstituents.
- Due to the presence of a chemical connection between the bioactive components and phosphatidylcholine, it has a higher stability profile.
- It improves the absorption of polar phytoconstituents, resulting in increased bioavailability of herbal extracts and hence better therapeutic benefits of herbal extracts (*Fry, et al. 1978*).

Planterosomal gels provide great potential for use in pharmaceutical and cosmetic formulations; nevertheless, to maximize their efficacy and application, many constraints need to be recognized and resolved (*Schwitters, et al. 1993*).

- Sometimes there is an issue with phytoconstituent leaching.
- Despite the multiple benefits of phytosomes, there is one limitation: phospholipids, namely lecithin, which are often used in conjunction with herbal extracts, can generate a mitogenic impact on the MCF-7 breast cancer cell line (*Athira, et al. 2014*).

Polyherbal Extracts used for Planterosomal Gel

Combining several medicinal plants to create polyherbs yields a wide range of bioactive chemicals with complementary therapeutic benefits. The incorporation of Polyherbs into planterosomal gels offers a viable way to improve the effectiveness and adaptability of topical formulations targeted at different health and skincare issues (*Nayak, et al. 2010*).

Neem Extract

The neem plant, Azadirachta indica, is widely known for its therapeutic qualities and is a key component of Ayurvedic and other traditional medical systems. The leaves, bark, and seeds of the neem tree are all medicinally beneficial. With a high content of chemicals as shown in Fig. 2 such as nimbin, nimbidin, and azadirachtin, neem has strong antiviral, antifungal, antibacterial, and anti-inflammatory qualities (*Singh, et al. 2011*). Its applications include oral hygiene, the treatment of skin disorders including psoriasis, acne, and eczema, as well as the management of illnesses like diabetes and digestive problems. Neem's many uses, which include agricultural applications and insect repellant, underscore its importance for environmental sustainability and overall wellness (*Weldegergis, et al. 2018*).

When incorporated into planterosomal gel, neem extract improves stability, sustained release, and distribution, hence increasing medicinal effectiveness. Neem bioactives are encapsulated in planterosomes, which makes it easier for them to permeate skin layers, protects them from deterioration, and releases them gradually at the application location (*Harahap, et al. 2018*). Through the action of substances such as azadirachtin, nimbin, and nimbidin, this technique combines neem's antiviral, antibacterial, antifungal, and anti-inflammatory qualities synergistically. With its extended presence and effective use of neem's bioactive components, the gel's mechanism of action promises improved treatment outcomes for a range of skin diseases, including traumas and dermatological illnesses (*Prasad, et al. 2017*).

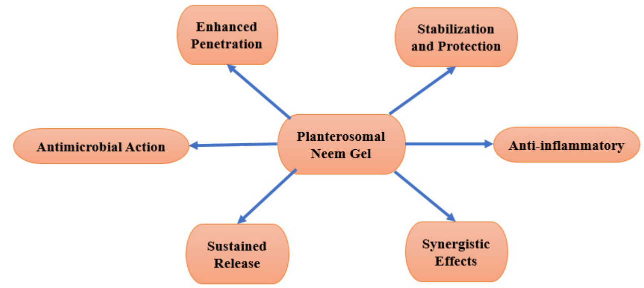

Fig. 2: Benefits of planterosomal gel of neem extract

Curcuma

Curcuma is a genus of flowering plants belonging to the Zingiberaceae family, which contains species like turmeric, or Curcuma longa. For millennia, people have valued turmeric's therapeutic virtues and appreciated its vivid yellow-orange rhizomes. Curcumin, the molecule that is active in it, has strong anti-inflammatory, antioxidant, and antibacterial properties as shown in Fig. 3. Turmeric is highly valued for its ability to heal a wide range of illnesses, such as skin diseases, digestive issues, and arthritis. It is also widely used in traditional medicine. It may be useful in the fight against chronic illnesses including cancer and Alzheimer's, according to recent studies. Worldwide, turmeric is still widely used in food preparation and medicine (*Zatz, et al. 2005*).

Curcuma extract, derived from the Curcuma longa plant, is a potent natural ingredient known for its anti-inflammatory, antioxidant, and wound-healing properties. When incorporated into the manufacturing of planterosomal gels for the treatment of skin injuries, Curcuma extract offers several benefits:

Planterosomal gels are formulated with curcumin extract, which is well-known for its ability to reduce inflammation and promote wound healing. Its curcumin presence minimizes scarring and speeds up wound healing by reducing inflammation and promoting collagen formation (*Singh, et al. 2014*). Curcuma extract is included in planterosomal gels to optimize therapeutic benefits by targeted distribution and controlled release. Through moisture retention and the maintenance of optimal conditions for tissue repair, these gels offer a moist

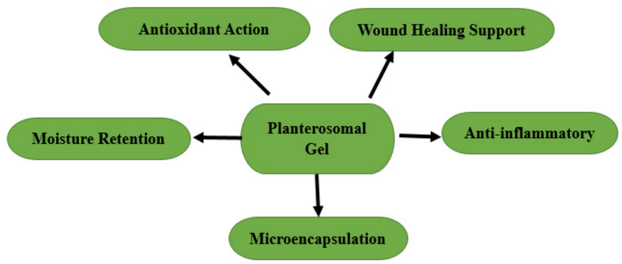

Fig. 3: Benefits of planterosomal gel of Curcuma extract

environment that promotes healing. Research is needed to improve formulation characteristics and evaluate clinical efficacy for different kinds of skin injuries, even though the results are encouraging (*M., et al. 2013)*.

Licorice

Because of its many advantages, licorice extract—which includes glycyrrhizin, glabridin, flavonoids, saponins, and polysaccharides—is highly valued as a component in skincare products. When added to polyherbal Planterosomal gel, it works in concert with other herbal extracts to offer all-encompassing skin care. Licorice is useful for dermatitis and eczema because of its anti-inflammatory qualities, which reduce redness and irritation (*Sandeep, et al. 2014)*. Its antioxidant function guards against pollution and UV ray damage, delaying premature aging. A more even complexion is encouraged by the skin-lightening properties, which aid in fading hyperpigmentation and imperfections. Its moisturizing qualities also keep the skin moisturized, avoiding dryness and preserving suppleness. To sum up, licorice extract in polyherbal gel provides a multipurpose skincare solution that addresses a range of skin issues and helps heal damaged skin (*Balouiri, et al. 2016)*.

Planterosomal Approach for Skincare

The focus of polyherbal skincare is on enhancing skin health through the use of various plant extracts in formulations (Table 1). Using the synergistic advantages of many herbs, this method addresses a variety of skin issues, including acne, aging, and inflammation. Every plant offers special substances including vitamins, minerals, and antioxidants, resulting in a comprehensive remedy. Aloe vera, turmeric, and neem together have been shown to have calming and anti-inflammatory properties. By harnessing the power of nature's abundance, herbal skincare offers a complete and natural substitute for conventional cosmetics, encouraging healthier, more beautiful skin (*Feng, et al. 2015)*.

To address a variety of skin issues, the polyherbal approach to skincare mixes various herbs for synergistic effects. Formulations provide all-encompassing treatment by balancing therapeutic benefits while avoiding dangers by combining herbs with complementary activities. Synergistic interactions result in enhanced effectiveness, enhancing the advantages of each plant individually (*Dongkai, et al. 2010)*. This method offers formulation versatility by enabling modification based on skin types and concerns. Time-tested effectiveness and scientific rigor are combined in polyherbal skincare, which is based on ancient wisdom and proven by contemporary research. In a succinct 100 words, this method stresses all-encompassing fixes, utilizing the diversity of nature to support glowing, healthy skin in the current beauty scene (*Xin Miao, et al. 2021)*.

The goal of the polyherbal skincare method is to improve skin health by utilizing the synergistic benefits of mixing various herbal substances. Polyherbal blends, as opposed to single-herb preparations, provide a holistic remedy by concurrently addressing many skin issues. Every plant adds different vitamins, minerals, and bioactive components that enhance its overall effectiveness (*Tianhong, et al. 2021)*. For example, a mixture of aloe vera, neem, and turmeric can hydrate while reducing inflammation and acne. Because of their complementary activities, research indicates that herbal mixtures frequently have increased therapeutic capabilities when compared to individual herbs. Furthermore, polyherbal formulations are renowned for having fewer side effects and a safer safety profile. Adopting an all-encompassing strategy may transform skincare by providing sustainable, natural, and efficacious methods for glowing, healthy skin (*Mazumder, et al. 2016)*.

Table 1: Different polyherbal extracts are used in the recuperation of damaged skin

Plant extract	*Family*	*Chemical constituents*	*Benefits*	*Part of plant*
Aloe vera	Asphodelaceae	Polysaccharides, anthraquinones	Soothes irritation, moisturizes, heals wounds	Leaves
Calendula	Asteraceae	Flavonoids, saponins, triterpenoids	Anti-inflammatory promotes wound healing	Flowers
Chamomile	Asteraceae	Flavonoids, sesquiterpenes	Calms sensitive skin reduces redness	Flowers
Green tea	Theaceae	Catechins, polyphenols	Antioxidant, anti-inflammatory, anti-aging	Leaves
Lavender	Lamiaceae	Linalool, linalyl acetate	Antimicrobial, relaxes skin, promotes healing	Flowers
Licorice	Fabaceae	Glycyrrhizin, flavonoids	Lightens dark spots, anti-inflammatory	Roots
Rosehip	Rosaceae	Vitamin C, carotenoids, flavonoids	Brightens skin stimulates collagen production	Fruit
Turmeric	Zingiberaceae	Curcuminoids, volatile oils	Anti-inflammatory, antioxidant, skin brightening	Rhizome

Conclusion

Advances in phytosomal technology have improved the bioavailability of plant extracts, notably polyphenols. It emphasizes the difficulties encountered in the absorption of polyphenolic components due to their low solubility in lipids and large molecular size. Phytolipid complexes, also known as phytosomes, are proposed as a strategy to address these difficulties and boost the bioavailability of herbal extracts. Several products on the market, like Ginkgo Select Phytosome and Meriva, use this technique to enhance the efficacy of plant-based medications. Studies have shown that phytosomal delivery methods are effective in treating illnesses such as oxidative stress, cancer, and obesity. Researchers created phytosome formulations of chemicals such as diosgenin and berberine to improve their solubility and bioavailability, with encouraging results in preclinical studies. Furthermore, self-assembled phospholipid-based phytosomal nanocarriers have been investigated as platforms for improving the bioavailability of anticancer drugs such as celastrol. The review study discusses phytosome's potential to revolutionize herbal extract distribution by creating efficient complexes with phospholipids. The experiments mentioned demonstrate the adaptability and usefulness of phytosomal technology in enhancing the therapeutic effects of plant-based medications. As the pharmaceutical industry seeks new drug delivery systems, phytosomes stand out as a viable way to improve the bioavailability and efficacy of herbal medicines.

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