A REVIEW ON HYDROGELS FORMULATION: NEWAPPROACHES FOR HERBAL MEDICINE

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ABSTRACT

Before the development of modern medicine, people relied on what are now called "traditional medicine" practises. These methods of care, as the term implies, have been handed down through the years and are unique to each country. The needs of the local population must be met for decades by a traditional system. Since the Vedic period and the dawn of human civilisation, traditional medicine in India has been widely practised. Hydrogels are three-dimensional structures made of hydrophilic homopolymers or copolymers that swell when exposed to water. They become impenetrable because their molecules have interlocked via chemical bonds or other cohesive factors like ionic contact, hydrogen bonding, or hydrophobic interaction. Unique formulation approaches that make use of colloidal carriers are essential for enhancing penetration. Submicron particles are used to deliver bioactive substances to the skin. Applying medication directly to the skin presents a number of challenges, including impermeability, low bioavailability, and only a small proportion of the active material reaching the target site. Herbal treatments have been used by humans for thousands of years because they are generally well-tolerated, effective, and culturally appropriate. Plants and plant products have been used to cure and prevent sickness for thousands of years, with varying degrees of success.

Keywords: Hydrogel, Formulation, Herbal, Medicine, traditional medicine

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INTRODUCTION

The World's Largest Botanical Garden, it’s possible that India grows more medicinal plants than any other country. Medicinal plants have been employed in some capacity for thousands of years by indigenous medical practises including Ayurveda, Sidha, and Unani. India is home to over one-fifth of the world's estimated 3.6 million medicinal plant species. According to recent studies, almost 70,000 different plants are employed in mainstream medicinal systems. Plants were the principal source of treatment for many ancient cultures. Herbal therapy was practised by all civilisations until the advent of modern western medicine, and at first, it was believed that synthetic chemicals were the most effective treatments for treating illness and curing disease. Before the development of modern medicine, people relied on what are now called "traditional medicine" practises. These methods of care, as the term implies, have been handed down through the years and are unique to each country. The needs of the local population must be met for decades by a traditional system. Since the Vedic period and the dawn of human civilisation, traditional medicine in India has been widely practised. Despite its long history and many changes, it continues to serve as the primary system of healthcare for a large percentage of the country's population. Traditional medicine is still popular in many parts of Asia. This includes China, India, Japan, and Pakistan. Traditional medicine began with plants used for their medicinal properties. Their relevance is growing (Kokate C.K., Purohit A.P. and Gokhale S.B. 2005).

HERBAL MEDICINE TODAY

For the time being, herbal medicine has merely improved upon and commodified tried and true practises. Several people turned to herbal therapy after being unhappy with the results of conventional or surgical care. The widespread continued usage of herbal medicines today is largely attributable to the general belief that they are harmless because of their all-natural composition. Pharmacologists don't use the entire plant; rather, they identify, isolate, extract, and synthetically recreate its active components. Plants contain a wide variety of substances, including as minerals, vitamins, volatile oils, glycosides, alkaloids, bioflavonoids, and more, that work together to give each herb its unique medicinal properties. In addition to providing essential natural defences, Toxic levels may be reached with much lower concentrations of isolated or manufactured active compounds, but it usually takes a lot more of the whole plant, with all of its ingredients, to become dangerous. However, plants are medicines and may sometimes have profound results. They should not be taken lightly at all. Several medicinal plants have been researched and proven effective all the way from Europe to Asia. Thanks to modern technology, scientists are able to discover some of the peculiar characteristics and interplays of plant components. Now that we have scientific proof, we know exactly why some herbs are effective in treating certain diseases. Research supporting herbal medicine, however, has thus far been almost exclusively undertaken in Germany, Japan, China, Taiwan, and Russia (Farasworth,N.R., Pezzuto, J.M. 1983; The Ayurvedic Phrmacopoeia of India.,Government of India 1999). When it comes to licencing new drugs (or substances for which therapeutic properties are claimed) for use in the United States, the Food and Drug Administration (FDA) often does not accept or recognise data from outside the country. Physicians and government agencies need strong scientific study to acknowledge the medical usefulness of a plant. Pharma companies and laboratories in the United States have not yet committed substantial funds or resources to botanical research, despite the fact that large research is being performed in other countries. Because of this, herbal medicine in the United States lacks the same visibility and social acceptance that it has in other countries (Kokate C.K., Purohit A.P. and Gokhale S.B. 2005).

Advantage of herbal medicines

When compared to conventional pharmaceuticals, herbal remedies provide many benefits. The following are some illustrations:

- Herbal treatments offer a lower risk of unwanted effects than conventional pharmaceuticals, and are often well-received by patients. Herbal treatments may be less dangerous than pharmaceuticals in the long run since they have fewer side effects (Mukherjii P.K. 2001).

- Cure for long-term health issues: When conventional medicine has failed to alleviate a persistent health problem, turning to an herbal remedy may be the best option. Some people get relief from arthritic symptoms by using herbal and alternative treatments. The popular arthritis drug Vioxx had to be pulled from the market because of an increased risk of cardiovascular issues. In contrast, there are seldom any negative effects associated with alternative treatments for arthritis. Some treatments entail making changes to one's diet, such as including certain herbs, staying away from the nightshade family of plants, or cutting down on white sugar.

- One further plus for herbal remedies is that they don't break the bank. Herbal remedies are far more cost-effective than conventional medicine. The high cost of prescription drugs is due largely to the time and money spent on their development, testing, and promotion. The cost of herbs is often lower than that of medications.

- Herbal medicines have widespread availability, which is a major plus. Over-the-counter stores sell herbs. Common household herbs may be grown successfully at home, including peppermint and camomile. Herbs may be the only kind of treatment available to people in remote areas of the world (Mukherjii P.K. 2001).

HYDROGELS IN TOPICAL DELIVERY

Hydrogels are three-dimensional structures made of hydrophilic homopolymers or copolymers that swell when exposed to water. They become impenetrable because their molecules have interlocked via chemical bonds or other cohesive factors like ionic contact, hydrogen bonding, or hydrophobic interaction. Hydrogels are elastic solids because, despite significant distortion, the system can always go back to its original, reference structure (Jain, S., Tiwari, A. K. 2005).

Physicochemical criteria for topical formulation

- Stability of the active ingredients
- Stability of the adjuvant
- Rheological properties- consistency, extrudability
- Loss of water and other volatile components
- Phase changes- homogeneity, phase separation

- Particle size and particles size distribution
- Apparent pH
- Particulate contamination.

Ideal properties of topical formulation

- Achieves a concentration in the target tissue that is sufficient to produce desiredpharmacological response
- preferable non-hazardous Leaving the skin in a condition that is inactive (as a metabolite).

Mechanism of topical delivery

The medicine in a topical pharmaceutical delivery system is absorbed by the skin and other superficial tissues after being applied to the skin. The intact stratum corneum between the follicular region and the sweat ducts is another potential entry site. There is little evidence that eccrine sweat glands significantly alter the skin's permeability. Although certain substances may enter the glands and ducts, they do not seem to enter the dermis. Chemicals ingested through the transepidermal pathway are absorbed rapidly, albeit at a slower rate than those absorbed by the intestines. Pilosebaceous penetration is usually present. Drugs absorbed by either channel must first cross the epidermis, since the pilosebaceous units provide only a limited surface area. The epidermis's surface area is between 100 and 1,000 times that of other absorption routes. The combined area of the skin's appendages, sweat glands, and hair follicles is probably between 0.1 and 1.0 percent (Bedde, H. E., Holman, F., Spies, A., Ponec, M. 1989). If an agent makes it through the stratum corneum, it's free to go through the rest of the epidermal layers and into the corneum, where it may then reach the bloodstream via the capillaries. The dermis is the effective endpoint of the concentration gradient at the start of circulation. In the body's circulatory system, drugs are stored and then quickly diluted and distributed, so they don't build up in any one place. Diffusion via the horny layer is a passive process. Little is known about the active transport systems present in stratum corneum cells. The only factors that may affect the passive process are the drug being absorbed, the medium through which it is dispersed, and the surroundings. However, epidermal diffusion and dermal clearance are two distinct stages in the more involved process of percutaneous absorption. This requires normal functions of the circulatory, lymphatic, and nervous systems, as well as the interaction of other factors with dermal components.[59]

Physical chemistry of percutaneous absorption

Little evidence suggests that active mechanisms are involved in skin permeation; hence, the underlying transport process is governed by simple passive diffusion. Fick's equations of diffusion may be used to examine and predict permeation data. The definition of Fick's first law, which is used to explain steady-state diffusion, is as follows:

$J = DK\Delta C / h$……………………………….(1)

D is the skin diffusion coefficient, K is the skin vehicle partition coefficient, C is the concentration gradient across the skin, and h is the length of the diffusion pathway.

Under normal conditions, the applied concentration (CAPP) is much more than the concentration beneath the skin, thus equation 1 is often simplified to:

$J = Kp_{*}\, C_{APP}$……………..(2)

Where Kp is a permeability coefficient (= KD/h) and a cm/h heterogeneous rate constant. As will become clear, it is sometimes impossible to distinguish between K and D, and their anticipated size will rely on 'h', which cannot be precisely measured due to the imprecise tortuosity of intracellular channels.

Drug absorption

When a medicine is applied topically, it is absorbed via the skin, a process known as percutaneous absorption. Both the carrier and the active component in a topical treatment have physicochemical properties that influence the rate and extent of drug release. In order to increase medication release and skin permeability, researchers have tried 55 different approaches, including choosing the right vehicle, co-administering a chemical enhancer, and using iontophoresis (Hadgraft, J. 1996). Applying medication directly to the skin presents a number of challenges, including impermeability, low bioavailability, and only a small proportion of the active material reaching the target site. Despite these limitations, traditional dermatological systems such as semisolid preparations (e.g., creams, ointments), liquid preparations, etc., remain widely used. Innovative dermatological formulations that are much more efficient and effective than standard topical methods may help with this. Numerous carrier systems, including liposomes, niosomes, transfersomes, ethosomes, solid lipid nanoparticles, and microemulsion, have been the subject of much research in recent years for topical medicine delivery.

Vesicular approaches for topical delivery system

Various vesicular systems are used to increase drug transport across the skin. They are as follows:

Hydrogels Formulation Approaches

Unique formulation approaches that make use of colloidal carriers are essential for enhancing penetration. Submicron particles are used to deliver bioactive substances to the skin. Some examples of such carriers are shown in Fig.1, and they include liposomes, nanoemulsions, and solid-lipid nanoparticles. Most reports highlight a localised effect, with carriers congregating in the stratum corneum or other upper skin layers. These colloidal carriers are not thought to be able to pass through living skin. However, these carriers' effectiveness is still up for debate.

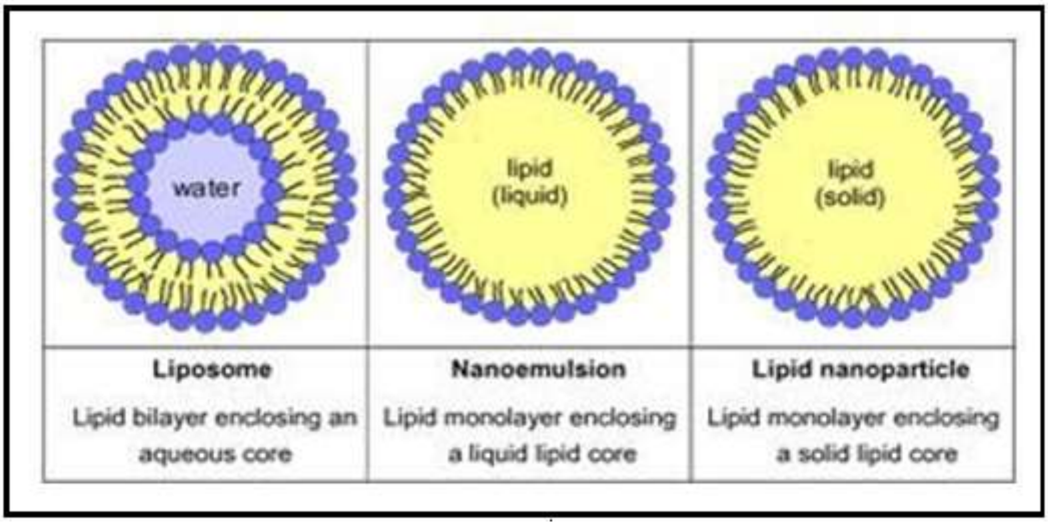

Figure 1: Vesicular approaches for topical delivery system

Liposomes

Self-assembling lipid bilayers called liposomes are made up of amphiphlic molecules like phospholipids and phospholipid-containing lipid mixes. These molecules can organise themselves into a lipidic bilayer that can enclose a minute volume of water-based fluid. The bilayer can accommodate hydrophobic molecules, whereas the interior aqueous volume can hold hydrophilic molecules. Liposomes are formed when a lipid film or lipid cake is hydrated, causing the stacks of liquid crystalline bilayers to become fluid and expand. Water does not interact with the hydrocarbon core of the bilayer at the margins because the hydrated lipid sheets detach and self-close during agitation, forming enormous multilamellar vesicles (LMV) (Touitou, E., Dayan. N., Bergelson. L., Gidin, B., Eliaz, M. 2000). After these particles are produced, further energy in the form of sound waves (Sonication) or mechanical force (extrusion) is required to reduce their size. Lipid formulations may have varying characteristics (cationic, anionic, neutral lipid species) depending on their composition.

Niosomes

Niosomes are non-ionic surfactant-based multilamellar or unilamellar vesicles in which an aqueous solution of solute is completely surrounded by a membrane formed by the bilayer structure of surfactant macromolecules.

Pharmacosomes

Colloidal drug dispersions called pharmacosomes are formed when drugs are covalently linked to lipids. The ultrafine vesicular, micellar, or hexagonal aggregation of pharmacosomes exists depending on the chemical composition of the drug-lipid combination. Surface and bulk interactions between lipids and water are required for the creation of vesicular pharmacosomes. To get over the restrictions of liposomes and niosomes, any drug having an active hydrogen atom (-COOH, -OH, -NH_3, etc.) may be esterified to the lipid, with or without a spacer chain.

Ethosomes

Phospholipids, a fair amount of alcohol (ethanol and isopropyl alcohol), glycols (polyols), and water make up the vesicular ethosomal system. The high ethanol content of ethosomes is thought to be responsible for their increased skin permeability. The vesicular nature of the eukaryotic cytoskeleton means that its constituent parts may vary in size from tens to hundreds of nanometers (nm).

Transfersome

Transfersomes are artificial vesicles that mimic the structure of cellular vesicles and are used to deliver drugs and DNA into cells. One natural amphipath (like phosphatidylcholine) that has a propensity to self-aggregate into vesicles makes up a transfersome. After that, at least one bilayer softener (such a biocompatible surfactant) is added to the latter. As a result, the Transfersome, which often takes the form of a vesicle, consists of an aqueous core surrounded by a highly fluid and adaptable lipid bilayer. The bilayer membrane of a Transfersome is "softened," making it more flexible and porous than that of a simple lipid vesicle (also called a liposome). This investigation on ethosomes' use as a smart drug delivery mechanism for anti-inflammatory therapy is timely. Here is a quick rundown of some of the most important aspects of today's smart delivery systems: (Table 1).

Table 1: Smart delivery system

Systems	Example	Delivers
Emulsions	Microemulsions, liquid crystals, multiple emulsion, nano emulsions, pickering emulsions	**Carotenoids, Vitamin A palmitate, free radical scavengers, nitrocellulose and antimicrobials.**
Particulate delivery systems	Microparticulates, porous polymeric systems, nanoparticulates, cyclodextrin, melanosponge	**Vegetable oil, tocopherols, retinal, tocopherols, genetically engineered melanin.**
Vesicle delivery systems	Ethosomes, liposomes, photosomes, niosomes silicone vesicles, matrices, multi-walled-delivery systems, phytosome, marinosomes ultrasomes, asymmetric-oxygen carrier system (AOCS) liposomes	**Photo-reactivating enzyme extracted from a marine plant, *Anacystis nidulans* catechin, quercetin, glycyrrhetinicacid, endonuclease enzyme.**
Other delivery systems	**Iontophoresis, cosmetic patches.**	**Vitamin C, E.**

Phospholipids, ethanol (at relatively high concentration), and water comprise the bulk of ethosomes, which are small bubble-like lipid vesicles that are soft and malleable. Intelligent vesicular carriers, these "soft vesicles" provide more even dispersion on and under the skin. Ethosomal system ingredients are clinically tested and approved for use in healthcare and beauty products. In comparison to liposomes and a number of commercial transdermal and dermal administration techniques, ethosomal systems were shown to be much more effective in terms of both the volume and depth of medicine delivery via the skin. Ethosomes are complex vesicular delivery vehicles that can carry many different kinds of chemicals. Ethosomes may be visualised as either unilamellar or multilamellar in its core, depending on the method used for visualisation. These novel delivery methods are made up of soft phospholipid vesicles that are stable in the presence of high concentrations of ethanol. In spite of their theoretical complexity, ethosomal systems are surprisingly easy to prepare, safe, and effective (Donatella P, Giuseppe L and Domenico M. 2005).

CONCLUSION

Natural active chemicals in medicinal plants may be utilised to relieve sickness and discomfort. Traditional medicines and medicinal plants are widely employed as preventative and curative treatments in the majority of underdeveloped countries. WHO reports that in developing countries, 80% of the population uses traditional medicines, mostly herbal plant cures, for primary healthcare. Many people are rediscovering the therapeutic value of plants as they seek healthier ways of living. Pharmacologists don't use the entire plant; rather, they identify, isolate, extract, and synthetically recreate its active components. Plants contain a wide variety of substances, including as minerals, vitamins, volatile oils, glycosides, alkaloids, bioflavonoids, and more, that work together to give each herb its unique medicinal properties. The problem with conventional medicine is that it doesn't treat the root of the problem, just the symptoms. Furthermore, most conventional therapies rely on specific compounds, which bacteria might eventually become resistant to.

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