REVIEW ARTICLE

Hydrogel-driven psoriasis therapies: Mechanisms, applications, and future directions

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ABSTRACT

Psoriasis is a long-term skin disorder characterized by the appearance of rashes or patterns on the skin that may be red, accompanied by itching and scaling. Psoriasis is an auto-immune illness that reinforms itself to the rhythmic division of keratinocytes. It currently affects an average of two to five percent of the world's population. Managing psoriasis remains a significant challenge due to various factors, including patient compliance with therapy, the complexity of patient conditions, psychosocial factors, and the dermis as a barrier to topical delivery. Hydrogels are the most advanced treatment carriers due to their biocompatibility, controllable characteristics, ability to deliver the required dose accurately, higher patient compliance rates, and reduced risk of side effects. This review aims to discuss the general principles that guide the design of hydrogel therapeutic platforms from various perspectives, including hydrogel constituents, tunable physicochemical properties, and interactions with cells and drugs, to enhance the understanding of the clinical applications of these platforms.

Keywords: Psoriasis, Hydrogels, Autoimmune disease, Management of psoriasis, Keratinocytes.

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INTRODUCTION

Psoriasis is hereditary – a long-term, painful, and immobilizing immunological disease of the dermis that has no cure and can only be treated with drugs that alleviate the symptoms.[1] The global prevalence rate of psoriasis was 2 to 5%, and regional variations were also found. Psoriasis has many forms, and among them, the most common is plaque-type psoriasis, also known as psoriasis vulgaris.[2] Psoriasis is divided into five types: Psoriasis vulgaris, inverse psoriasis, guttate psoriasis, pustular psoriasis, and erythrodermic psoriasis. About 80 to 90% of instances of psoriasis are Psoriasis vulgaris, which presents as well-defined plaques that converge and cover a significant portion of the body, the head, and arms. Reverse psoriasis develops into red, erosive plaques and patches in epidermal fissures.[3] This type of psoriasis primarily affects children and adolescents and is often triggered by Group A streptococcal respiratory infections, particularly tonsillitis. Approximately one-third of these cases may progress to plaque psoriasis in adulthood.[4] Psoriasis pustulosa palmoplantaris affects the palms and soles, while acrodermatitis continua of Hallopeau impacts the tips of the limbs and nails. Erythrodermic psoriasis, a severe and potentially life-threatening condition, requires immediate medical attention. [5]

Plaque type or psoriasis vulgaris

It affects an estimated 3% of the global population and is commonly known as plaque psoriasis or psoriasis vulgaris. This is the most frequent type of psoriasis, which affects about 80%-90% of all patients. The patients have fixed, gradually progressive plaques, which do not change much for a long time.[6] The lesions (Figure 1A) are variable in size, round, erythematous, dry, and often covered with multiple Silvery white micaceous scales. According to respondents, the areas involved most frequently include the elbow, knees, gluteal cleft, and scalp. Interdependence is always reciprocal, and this is usually the case where involvement is an important factor. The tropical patient presenting with slight or moderate pruritus is when accompanied by secondary, psychogenic stress, and lichenification is greater. Involvement of nails in up to 55% of the patients with white findings, such as onycholysis, subungual hyperkeratosis, and "oil drops".[7]

Guttate psoriasis (Eruptive psoriasis)

Often presents with small papules of limited time (weeks to less than one month). It is an acute form that is more common in younger individuals and is characterized by small, drop-shaped, red, and individual lesions on the skin, which are not as thick as those involved in plaque psoriasis and rarely form crusts.[8] The word guttate originates from the Latin word meaning 'drop.' Also referred to as teardrop psoriasis, raindrop psoriasis, or even the Manchester disease. These plaques are usually insignificant and do not extend to a size larger than 1cm in diameter (Figure 1B). It is usually related to acute group A-beta hemolytic streptococcal infection

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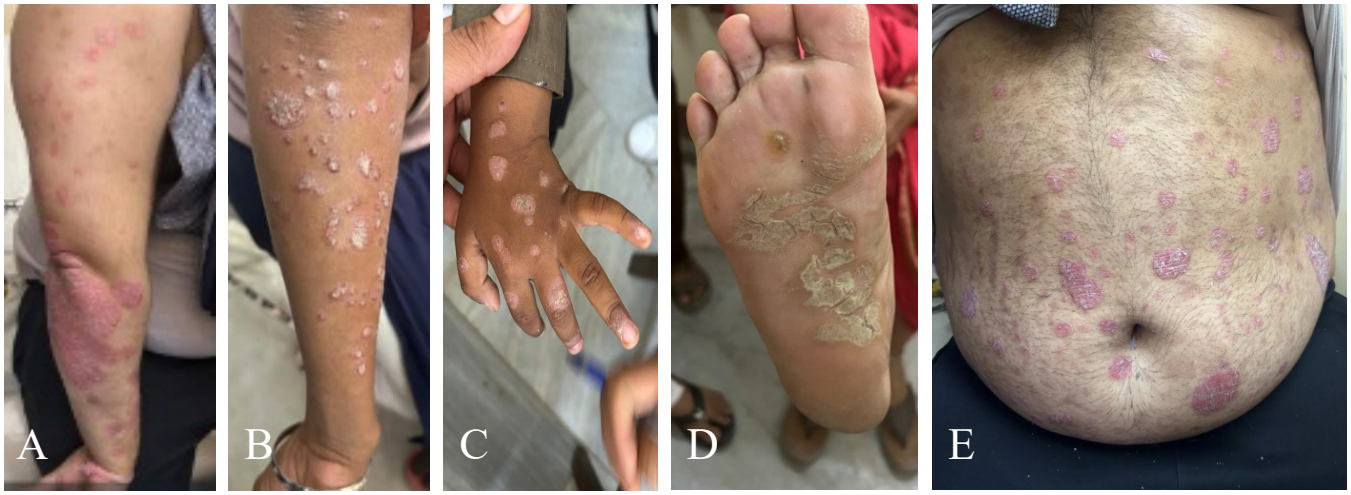

Figure 1: (A) Plaque type or psoriasis vulgaris, (B) Guttate psoriasis (Eruptive psoriasis), (C) Inverse psoriasis, (D) Pustular psoriasis, and (E) Erythrodermic psoriasis

of the pharynx in the last 7 to 10 days. There are relatively many cases of plaques, and they can manifest in any part of the body apart from the soles and palms. Most commonly seen in the trunk and limbs, though rarely seen in the face, ears, and scalp.[9]

Inverse psoriasis

Age-related and seen more frequently in children and in individuals who are classified as obese. The scaling process is significantly minimized, or in some cases, it can be considered entirely non-existent. Inverse psoriasis (Figure 1C) presents with symptoms of inflammation and bright red, smooth skin lesions.[10] Most body folds affected include the axillary region, the inguinal regions, the gluteal cleft, submammary folds, the vulvar area, and other folds. In obese or overweight patients, the symptoms may be present below the abdomen, where it folds. The skin of the lesions appears to have a glazed hue, while the folds show fissuring, which is a typical feature. If the skin of the folds rubs against one another, the condition will worsen, and sweating in the skin folds might also exacerbate it.[11]

Pustular psoriasis

Arising mainly in adults, this psoriasis (Figure 1D) is diagnosed by white pustules appearing as blister-like formations on the red skin without being associated with an infectious agent. It generally develops quickly. Psoriasis pustulosa can be localized and affect individual body regions, such as the palms and feet, or can be generalized, affecting the vast majority of the body's surface. The first clinical signs seen during its onset are erythematous skin lesions, pustules, and scaling. Some causes include internal medications, irritants, overexposure to UV rays, pregnancy, steroids, infections, and sudden withdrawal of systemic medication or potent topical steroids in pustular psoriasis. Pustular psoriasis can be categorized into two types – localized and generalized.
In the case of acute generalized pustular, the skin becomes dry and tender. The prodromes, if observed, are not very specific; then there is a sudden onset of high temperature and profound sickness. It follows that preexisting lesions turn red and develop pinpoint pustules. Any form of pustular exanthema may be observed, such as isolated pus, lakes of pus, circinate lesions, plaques of erythema, or generalized erythroderma.[13]

Erythrodermic psoriasis

Erythrodermic psoriasis (Figure 1E) is primarily an inflammatory type that usually involves much skin. It is commonly observed in patients experiencing unstable plaque psoriasis, especially when the borders of the lesions are not demarcated. This condition manifests as multiple periods of widespread erythema, accompanied by sheets of scales that shed rather than flake.[14]
This pathological condition has many applications concerning exfoliation (shedding of skin). Multiple symptoms are associated with these changes, such as erythema, exfoliation, itching, and pain. Erythrodermic psoriasis disrupts body metabolism, resulting in a loss of proteins and fluids that can lead to severe conditions like dehydration, malnutrition, and heart failure. Some complications include edema or swelling of dependent areas, such as the ankles, and infections. The control of continuous heat release and accumulation is often disrupted, resulting in shivering episodes. It was previously established that infections, pneumonia, and congestive heart failure triggered by erythrodermic psoriasis can be fatal. Those with severe forms of this disease often require treatment in hospitals.[15]

Complications16 of psoriasis include

- Infections
- Eczematization
- Pustulization
- Itching
- Burning and Tightness

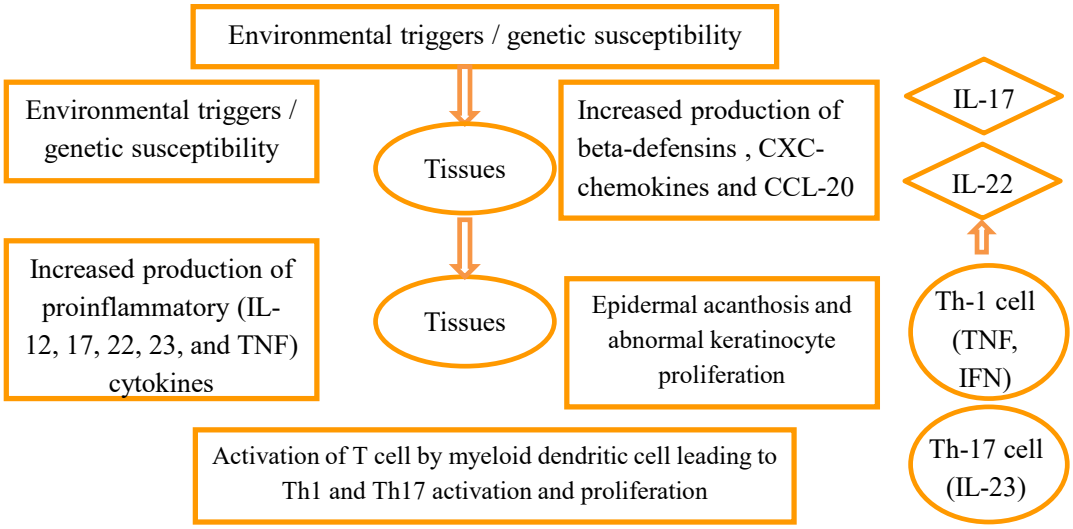

Figure 2: Pathophysiology of Psoriasis

- Hypocalcemia.
- Amyloidosis
- Arthritis
- Tumor formation

Therapeutics in psoriasis

The treatment a patient chooses for psoriasis depends on several factors, including the severity of the disease, its impact on the patient's daily routine, and the patient's attitude toward the disease.[17] Conventional medication for psoriasis is applied according to the severity of the condition. Depending on the treatment used, it can be effective in some patients with psoriasis and ineffective in others. Medications with agents with the lowest possibility of side effects are preferred. If the treatment goal is not attained, then such therapies with more toxicity are utilized during treatment.[18] Drugs with very high toxicity are limited to cases of Bureau de Seth severe unresponsive psoriasis. This is what is referred to as the 'psoriasis treatment ladder.' The first topical treatment taken is a topical treatment. If the topical treatment does not yield the intended results, the following action would be subjecting the skin to ultraviolet (UV) radiation. This kind of treatment is referred to as phototherapy. The third of them is the use of systemic medications. This means that psoriasis can develop resistance to a particular treatment that has been given in the long run. This is known as the policy of treatment rotation, which involves changing treatments periodically to prevent the possible development of resistance and minimize the risk of side effects.[19]

Onset of Psoriasis

Various factors contribute to its onset, and because it is progressive,[20] it is likely to worsen over time. Below is information regarding various triggers that cause the beginning of psoriasis.

Drugs

Numerous medications, including lithium, corticosteroids, antimalarials, and β-blockers, can lead to psoriasis. One of the most commonly known therapies that can induce psoriasis is practolol, a potential β-blocker. Psoriatic lesions have also been associated with other non-cardio-selective β-blockers, such as propranolol and pindolol.[21]

Endocrine Factors

Psoriasis is known to be directly affected by several hormones, including prolactin, thyroid hormones, and androgens. Menopause and puberty are the two primary stages at which the disease typically begins to manifest. According to a study involving roughly 65 women, 40% of pregnancies appear to be unaffected by the condition.[22]

Trauma

The epidermal areas subjected to rubbing or minor injuries, such as the knees and elbows, are affected by this disease known as psoriasis. It has been established that psoriasis is triggered by several physiological, chemical, and inflammatory skin irritations, such as abrasions, rubbing, and shaving.

Infection

This contains toxins, such as bacterial toxins, which activate T cells related to the cutaneous lymphocyte antigen, leading to the appearance of psoriatic lesions. Among all patients, the percentage of actual sickness as a result of infection varied between 15% and 76%. A study is available indicating a very close link between psoriasis infections and *S pyogenes*.[23]

Obesity

Some studies suggest that obesity is a pathogenetic factor in the disease, while other reports state that psoriasis

leads to obesity. According to some sources, it has been suggested that the proliferation of adipocytes, driven by pro-inflammatory cytokines, may contribute to the development of psoriasis.[23]

Pathophysiology

Pathogenesis encompasses inflammation, aberrant differentiation of epidermal keratinocytes, hyperproliferation of the epidermis, and alterations in the immune system resulting from various causes. Increased DNA synthesis is a primary feature of hyperproliferation and a markedly reduced epidermal turnover rate. Keratins (1 and 10) are expressed in the normal physiology of differentiating skin and appear later in psoriasis.[24] An increase in the expression of keratins such as six and sixteen indicates abnormal keratinocyte differentiation. Neutrophils filter the layers above the epidermis. Most $CD8^+$ cells are infiltrated into the dermis by T-cells.

Regarding the origin of psoriasis, there are two main theories. First, psoriasis is primarily characterized by excessive development and reproduction of skin cells, indicating a defect in the keratinocytes and epidermis (Figure 2).[25] Second, an immunological response occurs that triggers increased skin cell division. T lymphocytes shift from their primary role of fighting infections to become active, migrate to the dermis, and release cytokines, including tumor necrosis factor-alpha TNF, which promotes inflammation and increased skin cell growth. The cause of T cell activation remains uncertain.[26]

Treatment

Topical treatment refers to applying creams and ointments directly to the skin surface, and when used alone, can satisfactorily manage mild to moderate psoriasis. When the condition worsens, gels may be used in conjunction with oral medications or light therapy.[27]

Topical psoriasis medication includes:

Topical corticosteroids

These formulations commonly treat mild to moderate psoriasis. They help reduce inflammation and relieve itching and may be used alongside other treatments. Topical corticosteroids classified as class VII and VIII are typically prescribed for the face and in skin folds and for treating extensive areas of skin lesions.[28]

Vitamin D analogs:

These polymeric forms of Vitamin D inhibit epidermal cell growth. Calcipotriene, marketed by McNeil Consumer & Specialty Pharmaceuticals under the brand name Dovonex®, is a prescription cream or solution containing an agent that is a vitamin D analog for treating mild to moderate psoriasis, along with other agents. One might experience skin irritation while using calcipotriene. Calcitriol is cost-ineffective, but it may yield the same results as other drugs, presumably with fewer side effects than calcipotriene.

Anthralin

This drug helps reduce the rate at which skin cells divide. It is marketed under the brand name Dritho-Scalp® and can also remove the outer layer of the scalp, making it smooth. However, anthralin can cause skin irritation and stain materials, turning almost anything red. It is primarily used temporarily and is employed in transient crises or emergencies.

Coal tar

Derived from coal, coal tar helps alleviate scaliness, pruritus, and inflammation. However, it may also cause skin irritation. Additionally, it can be messy; this substance stained my clothes and the new comforter we bought for the guest room, and it has a relatively strong odor. Coal tar is present in many non-prescription shampoos, creams, and oils.[30]

Moisturizers

Lotions and creams won't cure psoriasis but can alleviate symptoms such as itching, scaling, and dryness of the skin. Due to their nourishing properties, moisturizers in an ointment base are typically more effective than light creams and lotions. Apply immediately after bathing or showering, and use a layer of oil on the skin to retain moisture.

Sunlight

High-density ultraviolet light, whether natural or artificial, impairs skin cell shedding, reduces skin scales, and inhibits new skin cell growth. Inflammation is also a concern. Psoriasis is arguably best managed by brief daily sun exposure to small areas of the skin, which may reduce the severity of the disease. However, sun exposure to areas significantly affected by the disease may exacerbate symptoms and lead to skin injuries. A doctor's guidance on when to start a sunlight regimen is crucial to determine the most effective way to utilize natural sunlight in treating psoriasis.[32]

Light therapy (phototherapy)

This treatment employs natural or artificial ultraviolet light (Table 1). The most basic and straightforward type of treatment involves exposing the skin to natural sunlight in a controlled manner. Light therapy exists in various forms, including natural or artificial ultraviolet A (UVA) rays, ultraviolet B (UVB) rays, and medications.[33]

Methotrexate

When taken orally, the drug Methotrexate, also known as Rheumatrex, is used to manage psoriasis by reducing the formation of skin cells and suppressing inflammation. It may also offer beneficial effects for some patients with psoriatic arthritis and may slow the progression of this disease. Low doses of Methotrexate generally do not cause significant side effects; however, potential side effects may include stomach upset and fatigue. Prolonged use has been associated with various complications, including severe liver diseases. This

Table 1: Synthetic drugs used in the treatment of psoriasis

Drugs	*mechanism*	*Application*
Methotrexate [36]	Thus, DHFR inhibition interrupts purine synthesis and activates apoptosis in lymphocytes.	Subcutaneous / Oral
Cyclosporin [37]	Calcineurin inhibition reduces the cytokine IL-2.	Oral
Etanercept [38]	The recombinant clusters analyzed in the current study are the functional dimeric TNF-α receptor mimotope, which is also known as the human fused fusion protein.	Subcutaneous
Adalimumab [39]	Monoclonal antibodies against TNF- α of human origin	Subcutaneous
Infliximab [40]	The role of retinoid receptor binding in normalizing keratinocyte proliferation	Intravenous
Acitretin [41]	Chimeric monoclonal IgG2 antibody produced in human lined at the IL-17 RA	Oral
Brodalumab Secukinumab [42,43]	The role of retinoid receptor binding in normalizing keratinocyte proliferation	Subcutaneous

can also lead to reduced production of red and white blood cells and platelets.

Cyclosporine

Cyclosporine also belongs to the category of immunosuppressants, comparable to Methotrexate in efficacy, but it should only be used in the short term. As with all other immunosuppressive drugs, cyclosporine can elevate your health complications, such as risks for infection and others.[35]

Hydrogel

Hydrogels are hydrophilic, three-dimensional networks that retain a large quantity of water, constituting a significant part of the human body. They are used for biomedical purposes and were first introduced into the discourse by Witchterle and Lim in the 1960s. Typically, hydrogels are crosslinked using physical or chemical techniques, primarily employed in drug delivery, cell culturing, tissue construction, and cell adhesion.[44] Hydrogel polymers can be categorized into two types: natural polymer hydrogels and synthetic polymer hydrogels. Synthetic polymers are formed through the chemical reaction of relatively small molecules of organic compounds. They exhibit high water absorption rates, favorable mechanical performance characteristics, a degree of biodegradability, and various advantages (Table 2).

Toxicity has limited the application of polymer hydrogel. Genetically, proteins, as a natural ingredient, are diverse; they contain different fundamental components that make them unique from the others. Coding structures and functions exhibit biocompatibility and bioresorbability. Hydrogel formulations are applied to the skin surfaces, which can be categorized into topical and transdermal routes. Topical formulations deliver the drug specifically to certain skin surfaces without systemic presentation, whereas transdermal formulations do so through the skin.

Preparations are applied topically in the area of the unavailable skin surfaces, which sustain and supply the effective concentration of the vehicle of the drug in the systemic circulation.[46]

This effect enables patients to tolerate the treatment more gently and experience fewer symptoms of aggression. It is also crucial that medications, formulations, or nutrients are available on the market at the right time.

Classification of Hydrogels

Based on their source, hydrogels can be categorized into two origins.[50] (1) Natural origins: Biopolymers can be extracted from the natural environment. They are water-based and comprise organic materials, including silk, wool, proteins, and DNA. (2) Synthetic polymers: Nylon, polyethylene, polyester, Teflon, and epoxy. Polymer networks comprising only one type of monomer—the fundamental structural element of all polymer networks—are referred to as homopolymeric hydrogels. The type of monomer and the polymerization method can influence the homopolymers' conjugated skeleton. Copolymeric hydrogels encompass more than one monomer species, each featuring a hydrophilic component. They are constructed randomly throughout the polymerization network from data blocks or in a pattern that reflects those variations.

Interpenetrating polymeric hydrogels, or multipolymer hydrogels, comprise two distinct cross-conjugated synthetic and natural polymeric substances formed into a complex shape. They are also referred to as interpenetrating networks (IPNs). A semi-IPN hydrogel consists of one part crosslinked polymer and one non-conjugated polymer. Categorization based on configuration: The following examples illustrate how the physical structure and chemical composition of hydrogels are utilized for classification: (a) Non-crystalline and structureless, (b) apparent-crystalline: a sophisticated mix of crystalline and amorphous phases, and (c) crystal clear.

Categorization according to crosslinking type

Hydrogels are classified into two kinds based on how the crosslink junctions behave chemically or physically. The material chain features short-term bonds, while chemically interlinked complexes have persistent bonds.[51]

Classification based on physical appearance

Depending on the presence or absence of charge,[52] crosslinked bonds usually appear as – (a) Unionized, (b) Ionic, and (c) Amphoteric.

Hydrogels can be synthesized by self-polymerizing the hydrophilic dimer using a versatile conjugate. Both natural and synthetic organic, water-soluble linear polymers are considered for their applications in aqueous environments. Synthetic crosslinked forms of hydrogels can be produced in several ways. Ionizing radiation creates main-chain open radicals coalescing into conjugated junctions. Solid-phase chemical methods are utilized to repair the solidified polymer chain. As a rule, three components are required to prepare the hydrogels: dimer and interconnect.

- *Solution crosslinking*

These are directed at the stage when ionic or noncharged monomers are combined with the multipurpose interconnecting agent. Two known methods for initiating the polymerization are thermal, via ultraviolet irradiation, or through the redox initiator system. The main difference between solution gelation and bulk polymerization is that the former involves a solvent, while the latter does not utilize one as a heat sink.[54]

- *Bulk polymerization*

As mentioned earlier, mass hydrogels can be prepared with more than one form of dimers, particularly vinyl monomers, for the formulation of hydrogels. In most cases, a tiny proportion of a crosslinking agent is embedded in any hydrogel. Standard methods of initiating gelation include radiation, ultraviolet light, or chemical catalysts in chemical reactions. The first step is determined based on the different types of dimers and solvents employed for polymerization. The hydrogel may be rods, beads, films, or many other formations, including membranes and emulsions.

- *Free radical crosslinking*

The main dimers used for synthesizing hydrogels in this approach are acrylates and amides. These synthetic resins have appropriate functional groups or have been modified with radically polymerizable groups to form a polymer matrix with the polymers. This mechanism is nearly identical to common free radical polymerization reactions, such as initiation, chain transfer, and propagation. It is possible to employ initiators with a wide variety of heat, UV, visible, and redox sensitivity to facilitate radical formation during the initiation stage. Reactive oxygen species combine with the subunits to convert them into active states.[55]

- *Inverse-suspension polymerization*

One benefit of this technique is that it produces goods in the form of granules, microspheres, or fragments, thus negating the need for crushing. The previously widely used oil-in-water (O/W) method has been replaced with the water-in-oil (W/O) process. When the O/W ratio is utilized, as mentioned above, the polymerization is referred to as "the reverse suspension." In this method, the starting point and polymers remain submerged in the petroleum phase as a homogeneous solution, which aids in the polymerization of the monomers and the synthesis of the polymers. When determining the amount of resin in the substance being used, which controls the thickness of the monomer solution, several factors must be considered: the rotating geometry, the speed at which the particles spin, and the type of dispersant employed, as both the size and character of the particles are essential considerations. Due to its mechanical sensitivity, the system requires continuous stirring and the addition of an agent with a low hydrophilic-lipophilic balance (HLB) that suspends the particles.

- *Grafting to support*

Because the hydrogels prepared by mass polymer formation are fragile, it becomes necessary to enhance the hydrogel's dynamic properties so that it can be grafted onto a more robust substrate. This involves creating reactive oxygen molecules on a more durable material surface and then polymerizing the monomers back and forth directly on a solid support to form a chain of monomers involving covalent bonds.

- *Polymerization by irradiation*

Ionizing, an extremely powerful irradiation, is one of the initiators used to hydrogenate unsaturated molecules. It has been found possible to use electron beams and gamma rays. Treating a polymer that dissolves in water with an aqueous solvent is known as "exposure of aqueous polymer solution." Radicals are created as a result of the polymeric bonds. Interactions of the macro-radicals with one another are involved in the recombination of their members differently. In other words, chains form covalent bonds by interacting, resulting in an interconnected structure. Relatively, hydrogels

Table 2: Advantages and disadvantages of hydrogels

Advantages[47,48]	*Disadvantages*[49]
High elasticity and mechanical strength. It is pretty flexible due to its highly hydrophilic nature, which closely resembles natural tissue. Good transparency and are relatively simple to modify. Biocompatible, biodegradable, and injectable. Able to detect changes in pH, temperature, or metabolite levels and adjust accordingly. Resist the accumulation of protein deposits.	1. High cost. 2. Lower mechanical strength. 3. Difficult to sterilize. 4. In contact lenses, less deposition leads to hypoxia, mites, and red-eye reactions. 5. Non-adherent properties.

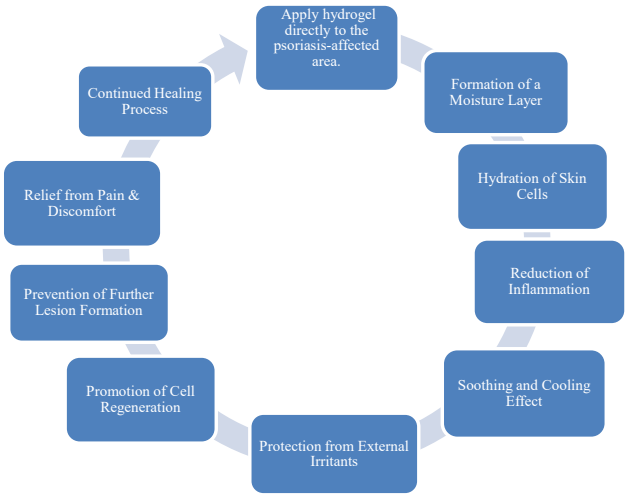

Figure 3: Mechanism of hydrogel on psoriasis

without initiators and containing pure hydrogel networks are also formed by this process.

Physical crosslinking

It is an extremely popular and straightforward process for creating hydrogels through the chemical connection of polymers. This physiological crosslinking involves ionic phenomena such as polyelectrolytes and hydrogen bonds, as well as both hydrophobic interactions and associations.[59] The numerous tact ignition forms adopted for physiologically interconnected hydrogels are:-

- *Heating/cooling polymer*

To create a polymer solution for cooling and heating, warm solutions of collagen or carrageenan are cooled to form gels through physical crosslinking. The helical connection, helix-structure development, and gel connection zone formation are all credited with the gel's formation.[60]

- *Coacervation*

The overlapping of coacervates occurs when polyanions mix with polycations. This method is based on the attraction between polymers with opposite charges, which also depends on the concentration and pH of the solutions containing these ions, as well as the quantity of soluble and insoluble complexes.[61]

- *Ionic interaction*

Cross-bonding between polymers occurs when di- or trivalent counter ions are added to an ionic polymer. Examples include chitosan-polyline, chitosan-glycerol phosphate salt, chitosan-dextran hydrogels, and other combinations.

- *Hydrogen Bonding*

An electron-poor hydrogen atom interacts with this functional group, which has a high electron count, to form a hydrogen bond. For example, forming a hydrogel from PA and PNVP can result from the development of hydrogen bonds. The molar ratio of each component, which affects the properties of hydrogels, is one of the key factors. The molar ratio of each polymer used, the quantity of the polymeric material, the type of solution utilized in the polymer solution, its drying temperature, and the resin's polymer structure are the variables that influence it.[62]

Drug Release Mechanism

Diffusion-controlled

The hydrogel drug release process is predominantly diffusion-controlled in most cases. Fick's law is especially relevant when choosing between constant or variable diffusion coefficients for diffusion-controlled release. In many instances, drug diffusivities are measured experimentally or assessed a priori, as free research shows that HPC separations cannot be fully explained by mass or hydrodynamic factors.

Chemically controlled

The term chemically controlled refers to the ability of molecules to be released under specific controls during transformative processes in delivery systems. The frequently reported interactions in hydrogel delivery systems involve coatings that trigger the release of encapsulated materials. These processes can include polymer scission via hydrolysis or enzymatic action, as well as reversible or irreversible methods. Interactions formed within the polymer network also influence the release of the drug. In some cases, it is possible to interact with the object directly from its surface or through the oral disintegration of hydrogels, as needed in large amounts, which aids in regulating the timing of drug release. If drug-binding substances are present, other drug design elements can be managed to achieve the desired pharmacokinetic and pharmacodynamic profiles. However, the binding state may influence the drug release rate if the medicinal product is incorporated into the hydrogels. Depending on the type of chemical reaction occurring during drug release, this chemically controlled distribution can be

categorized in various ways. Generally, the breakdown of pendant chains or the process of superficial attrition or bulk degradation of the polymer matrix may facilitate the release of encapsulated or attached medications.

Mechanism of hydrogel on psoriasis

Hydrogels can aid in managing psoriasis when used effectively, as psoriasis produces red, flaky patches that mimic wounds (Figure 3). Furthermore, individuals with psoriasis typically experience dry skin, which is often accompanied by irritation, which significantly negatively impacts the patients. Due to their physically indented hydrophilic porous polymeric structure, hydrogels can retain water and hydrate wounds. They are also hydrophilic, enhancing the rate of transportation of host cells while reducing strain and swelling in the areas where the hydrogel is applied, such as the lesions. Hydrogels can diminish the spindle action of psoriatic plaques, helping to prevent excessive skin cell proliferation. Additionally, they serve as a slight barrier that protects the affected psoriatic skin from the outside environment. Unlike creams, lotions, or ointments, hydrogels can be modified to allow certain medications to penetrate the skin's deeper layers more effectively and regulate the duration of the molecules.

CONCLUSION

Psoriasis is an immunologic disorder with many facets and cannot be managed in an acutely adaptive manner. Drug treatment can be ineffective, and patients often have limited therapeutic resources. Compliance is critical. For several reasons, hydrogels are a more effective solution than traditional methods. Skin therapy helps manage psoriasis functionally by moisturizing the skin to alleviate itching while allowing the drug to maintain prolonged contact with the skin. Applying specific polymers enables the characteristics of the hydrogel to be adapted and refined, enhancing drug delivery and improving the patient experience. The outcomes of psoriasis treatment with hydrogels demonstrate the potential of this platform technology for topical drug delivery, which remains a well-established procedure with advanced capabilities. This technology offers potential advantages over other formulations, making it a strong candidate. Information about other anti-psoriatic drugs is dependent on knowledge related to this technology.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.