

Hydrogel Based Controlled Drug Delivery for Psoriasis

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Abstract: *Psoriasis is a chronic inflammatory skin disorder that affect millions of people worldwide . current treatments for psoriasis include topical corticosteroids , immunomodulators and phototherapy but these treatments may have limited efficacy or cause side effect . curcumin a natural compound with anti-inflammatory and antioxidant properties has been shown to have potential as an alternative treatment for psoriasis . however the low solubility and bioavailability of curcumin limit its effectiveness when administered orally or topically . curcumin hydrogel a topical formulation of curcumin has been developed to address these limitation . in this review we summarize the current research on the use of curcumin hydrogel in the treatment of psoriasis . we discuss the pharmacological properties of curcumin the formulation of curcumin hydrogel and the preclinical and clinical studies investigating the efficacy and safety of curcumin hydrogel in psoriasis . overall the available evidence suggests that curcumin hydrogel may be a promising alternative treatment for psoriasis with potential benefits in reducing inflammation , promoting wound healing, and improving overall quality of life for psoriasis patients . further research is needed to fully elucidate the mechanism of action curcumin hydrogel and to optimize its formulation and delivery for maximum efficacy.*

Keywords: curcumin, psoriasis, hydrogel, turmeric

I. INTRODUCTION

Traditional medicine has a long history of using natural and herbal products to treat various human diseases, and it has now become a multi-billion-dollar industry with a recorded cost of USD 10 billion/year . (1) Curcumin a polyphenol derived from the turmeric plant (curcumin longa) of the zingiberaceae family , is one of the numerous herbal compound available for medical purposes for centuries, including spice, food additive (e.g , ice cream,yogurt,orange juice, biscuits , popcorn, cake,gelatins),cosmetic ingredients ,and natural product for treating different diseases, particularly chronic inflammatory condition . although the therapeutic benefits of curcumin have been recognized for centuries its pharmacological properties have only been scientifically studied in the past century . today the wide range of curcumin's medical application is attributed to its various properties ,including antioxidant , anti-inflammatory , anti-carcinogenic , anti-carcinogenic,and anti-microbial effect. In medicine , curcumin is used to treat various diseases, such as rheumatoid arthritis ,eye diseases(e.g chronic anterior uveitis , conjunctivitis), urinary tract infections, menstrual disorder,liver and gastrointestinal disorder (e.g abdominal pain , inflammatory bowel disease). Additionally, curcumin is used as an adjuvant therapy for treating skin cancer, chickenpox, and wound healing although curcumin can be obtained from the diet, it is now formulated into tablet with different dosages , often combined with specific adjuvant (e.g piperine , phospholipids) that improve its absorption and bioavailability (2)

II. AIM AND OBJECTIVE

Aim: hydrogel based controlled drug delivery for psoriasis treatment

Objective of the study

- Anti-inflammatory effects: reduce inflammation associated with psoriasis.
- Symptom relief : alleviate itching and scaling.
- Enhanced delivery : improve skin penetration of curcumin.
- Moisturization : hydrate and soothe the affected skin.

- Antimicrobial action: prevent secondary infection .

III. IDEAL PROPERTIES OF TURMERIC HYDROGEL

- Biocompatibility : safe for use in skin and does not cause irritation.
- High curcumin stability : protects curcumin from degradation.
- Controlled release:provides sustained release of active ingredients.
- Moisturizing capability: maintains skin hydration.
- Antimicrobial properties: inhibits microbial growth.
- Good mechanical strength: resilient and durable durable use.
- Non-greasy texture : comfortable for users.

IV. PLAN OF WORK

1. Selection of the topic.
2. Collection of the information.
3. Analyzing of the information.
4. Arrangement of the information.
5. Writing on review projection on turmeric hydrogel.

V. OVERVIEW OF PSORIASIS

5.1 Epidemiology

psoriasis affects both male and female , with earlier onset in females and those with a family history . its age of onset shows a bimodal distribution with peaks at 30-39 years and 60-69 years in men and 10 years earlier in women .

5.2 Aetiology

the pathogenesis of psoriasis is multifactorial , with genetics begins a primary contributor especially in those with early-onset (<40years) plaque psoriasis . this was demonstrated by twin , family based and large-scale population-level studies , with heritability estimated to be 60-90%.5 more than 60 susceptibility loci have now been identified using genome-wide association studies.5Many of the candidate causal genes are involved in antigen presentation (HLA-C and ERAP1),NF-kappa B signaling (TNIP1),type 1 interferon pathway (RNF113 and IFIH1),interleukin (IL)23/Th17 axis (IL12B and TYK20 and skin barrier function (LCE30 . this suggest a complex interplay between T cell, dendritic cell and keratinocytes as the likely underlying the pathophysiology of psoriasis ,with the IL-23/Th17 axis being the central driver of immune activation , chronic inflammation and keratinocyte proliferation.6 environmental triggers have been known to exacerbate psoriasis such as obesity, stress , beta blocker, smoking and lithium .7 although there is a relative paucity of data , pustular psoriasis appears to be genetically distinct, with different susceptibility genes implicated (IL36RN,AP1S3in those of European descent and CARD14.(3)

5.3 Pathophysiology

The pathophysiology of the psoriasis is involves in infiltration of the skin by activated T cell which stimulate the proliferation of keratinocytes . this dysregulation in keratinocyte turnover results in the formation of thick plaques. Other associated features include epidermal hyperplasia and parakeratosis.in addition , the epidermal cell fail to secrete lipids which results in flaky and scaly skin, which is typical of psoriasis . the pathophysiology of psoriasis is multifactorial and involve epidermal hyper proliferation , abnormal differentiation of epidermal keratinocytes, and inflammation with immunologic alteration in the skin . the hyper proliferation is characterized by increased DNA synthesis and a markedly decreased turnover rate for the epidermis . abnormal keratinocytes differentiation involves increased expression of certain keratins(6 and 16) and a delay in expression of other keratins (1 and 10) that are expressed in normally differentiating skin . inflammation results from an infiltrate of neutrophils in the epidermis and superficial dermis and an infiltrate of T lymphocytes in the dermis with a predominance of CD8+cell.(4)

5.4 Symptoms and triggers of psoriasis

dry , cracked skin that may bleed .

a patchy rash that varies widely in how it looks from person to person , ranging from spots of dandruff-like scaling to major eruption over much of the body .

rashes that vary in color, tending to be shades of purple with gray scale on brown or black skin and pink or red with silver scale on white skin.

Small callings pots (commonly seen in children).

Itching , burning or soreness.

5.5 Psoriasis triggers

many people who are predisposed to psoriasis may be free of symptoms for years until the disease is triggered by some environmental factor. Common psoriasis triggers include:

infection , such as strep throat or skin infection .

weather, especially cold , dry condition .

injury to the skin .

heavy alcohol consumption .

Certain medications-including lithium, high blood pressure drugs and antimicrobial drugs.

Rapid withdrawal of oral or injected corticosteroids.

5.6 Complication

Secondary infection

Poor cosmesis

Psoriasis of lymphoma

Psoriasis arthritis

Increased risk of adverse cardiac events

Obesity

Type 2 diabetes

Psoriasis arthritis which cause pain, stiffness and swelling in and around the joints

Temporary skin color changes (post inflammatory hypopigmentation or hyperpigmentation) where plaques have healed

Eye condition , such as conjunctivitis , blepharitis and uveitis

Cardiovascular disease

Mental health condition , such as low self-esteem and depression

Other auto immune disease , such as celiac disease , sclerosis and the inflammatory bowel disease called crohn's disease.(5)

5.7 Types of psoriasis :

there are different types of psoriasis :

psoriasis arthritis:

an inflammatory rheumatic disorder of unknown etiology occurring in patients with psoriasis is named as psoriasis arthritis . an authenticated set of classification criteria for psoriatic arthritis having specificity of 98.7% and sensitivity of 91.4% and has recently established by the classification criteria for psoriasis arthritis group.



Fig 1.1 psoriasis arthritis

pustular psoriasis :

the patients who are suffering from pustular psoriasis or related pustular diseases may genetic abnormalities which impair the function of crucial players of the innate skin immune system. Detection of these irregularities has changed the paradigm of these diseases recently.



Fig . 1.2 pustular psoriasis

Palmoplantar psoriasis :

Plaque psoriasis that involved the palms and soles is characterized as palmoplantar psoriasis . this type of psoriasis is a challenge for dermatologists that is difficult to be treated with topical and systemic therapies.



Fig . 1.3 palmoplantar psoriasis

Scalp psoriasis :

Scalp psoriasis can affect patients' lives harmfully and is often resistant to the treatment that has not been a major focus of a scientific study. The activity of secukinumab of patient-reported outcomes of scalp psoriasis is evaluated by this analysis.

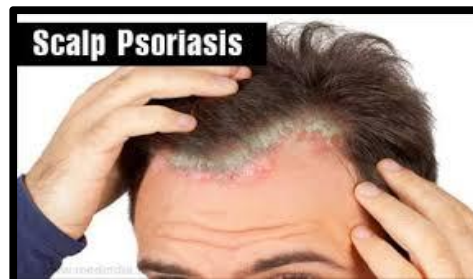


Fig .1.4 scalp psoriasis

Nail psoriasis :

About 80% patients with psoriasis are likely to develop nail psoriasis as a result of the condition of their nail as nails are considered epidermal appendages . psoriasis can cause nail disorders of two patters.(6)



Fig.1.5 nail psoriasis

Chronic plaque psoriasis :

Among different types of psoriasis , the most common one is plaque psoriasis or psoriasis vulgaris. Almost 85% of people with psoriasis have plaque psoriasis which is characterized by thick red patches of skin , often with a silver or white flaking layer.



Fig . 1.6 chronic plaque psoriasis

Guttate psoriasis :

Streptococcal infection like pharyngitis or perianal infection classically triggered a distinct variant of psoriasis called guttate psoriasis which is more common in kids and adolescents than adults. In this case, patients severely present small drop like lesions which respond well to topical treatments and phototherapies.



Fig.1.7 guttate psoriasis

Erythrodermic psoriasis:

Erythrodermic is a scaly erythematous dermatitis that involves 90% or more of the cutaneous surface. The most mutual dermatoses underlying erythroderma are psoriasis and eczema. Erythroderma may be also caused by cutaneous T cell lymphomas.(7)



Fig.1.8 erythrodermic psoriasis

Current treatment of psoriasis :

topical treatment :

these go on your skin and are usually the first thing doctors try. Some have steroids; others don't. prescription products slow skin cell grow and ease inflammation .

phototherapy :

this treatment uses ultraviolet light. You'll get it at your doctor's office or at home with a phototherapy unit.

Systemic medication :

These prescription drugs work throughout your body. You'll get them if you have moderate to severe psoriasis is that doesn't respond to other treatment . you could take the M by mouth or get them as a shot or IV . this category includes drugs called biologics, which target specific parts of your immune system that play a role in the inflammatory process. Learn more about systemic treatment for psoriasis.

Corticosteroids :

These drugs are the most frequently prescribed medications for treating mild to moderate psoriasis . they are available as oils, ointments, lotions, gels, foams, spray and shampoo. Mild corticosteroids ointments (hydrocortisone) are usually recommended for sensitive areas , such as the face or skin fold , and for treating widespread patches.

Vitamin D analogues :

Synthetic forms of vitamin D such as calcipotrien (Dovonex, sorilux) and calcitrol (Vectical) slow skin cell growth. This type of drug may be used alone or with topical corticosteroids . calcitriol may cause less irritation in sensitive areas

Retinoids :

Tazarotene (Tazorac , avage , other) is available as a gel or cream. Its applied once or twice daily. The most common side effects are skin irritation and increased to light. Tazarotene isn't recommended when you're pregnant or breastfeeding or if you intend to become pregnant.

light therapy :

light therapy is a first treatment for moderate to severe psoriasis , either alone or in combination with medications. It involves exposing the skin to controlled amounts of natural or artificial light. Repeatd treatments are necessary.

Sunlight:

Brief, daily exposures to sunlights (heliotherapy) might improve psoriasis . before beginning a sunlights regimen, ask your health care provider about the safest way to use natural light for psoriasis treatment.

Antibiotics:

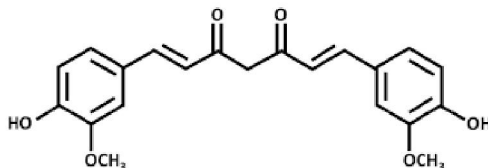
Tetracycline and penicillin use of systemic antibiotic and induction of gh reduction of intracellular cAMP and interavtion with arachidonic acid and its mentabolites.

Lithium:

Lithium is used for the treatment of manic-drpressive disorder. In 1972, the first lithium induced psoriasis was reported. There are several therapies purported to explain the pathogenesis of liyhium provoked psoriasis.(8)

VI. CURCUMIN

Chemical structure of curcumin:



Molecular formula: C₂₁H₂₀O₆

Molecular weight : 368.35g/mol

IUPAC name : (1E,6E)-1,7-bis(4hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione

Properties of curcumin :

Antibiotic

Analgesic

Anti-inflammmtory

Antioxidant activity

Improves skin condition (psoriasis , eczema)

Speeds up wound healing.

VII. REVIEW LITERATURE

Veronica di nardo,et al. use of curcumin in psoriasis:

Curcumin is a polyphenol derived from the golden spice turmeric, which is widely used for different purposes, such as culinary spice and alimentary additive, made up and finally as a natural product for the treatment of different diseases, especially for the chronic inflammatory ones. Recently, curcumin has been proposed as a valid and safe therapeutic option for psoriasis.

Ying peng et al. anti-inflammatory effects curcumin in the inflammatory diseases: status, limitations and countermeasure :

Curcumin is a natural compound with great potential for disease treatment. A large number of studies have proved that curcumin has a variety of biological activities, among which anti-inflammatory effect is a significant feature of it. Inflammation is a complex and pervasive physiological and pathological process. The physiological and pathological mechanisms of inflammatory bowel disease, psoriasis, atherosclerosis, COVID-19 and other research focus diseases are not clear yet and are considered to be related to inflammation. The anti-inflammatory effect of curcumin can effectively improve the symptoms of these diseases and is expected to be a candidate drug for the treatment of related diseases.

Tahmina haque,et al. treatment and management of psoriasis:

Psoriasis is a common, chronic inflammatory skin disease affecting many people of the world now a days. Psoriasis is principally an immunological T lymphocyte-driven disease, relating both the distinctive and T cell mediated immune system. The mostly affected site comprise the scalp, extensor surface of the kness and elbows, umnlicus, gentitslia, anterior lower legs and nails. This disease can significantly impact on a patients's quality of life and is connected comorbidities comprise psoriatic arthritis, obesity and the metabolic syndrome, diseases of cardiovascular system and liver with fats. provided treatment is depends on disease severity, quality of life preference, relevant comorbidities and efficacy of the treatment.

VIII. TURMERIC

8.1 History of turmeric

Turmeric (curcumin longa) and several other species of the curcumin genus grow wild in the forest of southern asia including India, Indonesia, Indochina, nearby asian countries and some pacific island including Hawaii. all of these areas have traditional culinary and medicinal uses going back to pre-history. in the Indian ayurvedic system of herbal medicine, turmeric is known as strengthening and warming to the whole body. traditional uses in Indian include to

improve digestion , to improve intestinal flora to eliminate worms to relieve gas to cleanse and strengthen the liver and gallbladder to normalize menstruation , for relief of arthritis and swelling,as blood purifier,to warm and promote proper metabolism correcting both excesses and deficiencies dor local application on sprains,burns,cuts,bruises,insect bites and itches,for soothing action in cough and asthma as antibacterial and antifungus and in any condition of weakness or debility.(9)



Turmeric

Synonym of turmeric : halad ,Indian saffron , haldi, amesha

Biological source : the palnt of curcuma longa linn is (c.domestics), a member of the zingiberaceae family , produced both dried and fresh rhizomes that are used to make turmeric . it contains at least 1.5% curcumin. 10)

Chemical constituents : the amount of the resin,volatile oil,copious zingiberene starch grains which are turmeric its yellow color , is around 5%.

Taxonomical classification of curcumaInga:

Scientific name : curcuma longa

Kingdom: plantae

Subkingdom: tracheobionta-vascularplants

Super division : spermatophyte(11)

IX. MECHANISM OF ACTION

9.1 Anti-inflammatory

Numerous chronic diseases have been linked to oxidative stress, and since one these diseases can easily cause the other its pathological process are quite similar to those of inflammation . in reality the association between oxidant stress and inflammation is denmonstrated bt the fact that inflammatory cells release a variety of reactive species at the site of the inflammation which cause oxidative stress.12)

9.2 Health benefits of turmeric in our daily life

It is a natural antiseptic and antibacterial agents, useful in disinfecting cuts and burns.

Prevented breast cancer from spreading to the lungs in mice.

May prevent melanoma and cause existing melanoma cells to commit suicide.

Reduced the risk of childhood leukemia.

Is a natural liver detoxifier.

Is a natural painkiller and cox-2 inhibitor

May help in the treatment of psoriasis and other inflammatory skin condition.

Has been shown to stop th growth of new blood vessels in tumors.

May aid in fat metabolism and help in weight management.

Has long been used in Chinese medicine as a treatment for depression.(13)

X. HYDROGEL

much scientific research has been done in the field of biomaterials that play a role in human health (14). In this article, we review hydrogel which is one of the main topics in biomaterials research. Hydrogel are water-insoluble three-dimensional polymer network that have the ability to absorb large amount of water or biological fluid in the body due to the presence of hydrophilic groups in their structure (15-16). Among the hydrophilic functional groups in the main polymer chain of hydrogel we can mention the hydroxyl groups (OH-), carboxyl (COOH-), amine (NH₂) and sulfate (SO₃H-)(17). Polymeric hydrogel can be formed by physical crosslinking, chemical crosslinking or a combination of both types (18).

10.1 Advantages

Hydrogel is more elastic and stronger.

Hydrogel possess good transparent properties and easy to modification.

Due to their significant water content they possess a degree of flexibility very similar to natural tissue.

They are biocompatible, biodegradable and can be injected.

Hydrogel have ability to sense change pH, temperature or the concentration of metabolite and release their load as result of such a change.

Release of medicines or nutrients timely.(19)

10.2 Disadvantage

High cost

Non-adherent and may need to be secured by secondary dressing and also cause sensation felt by movement of the maggot.

Difficult to sterilize.

In contact less deposition hypoxia, dehydration and red eye reaction.(20).

10.3 Hydrogel technical features:

The functional features of an ideal hydrogel material can be listed as follows:

The highest absorption capacity in saline.

Desired rate of absorption depending on the application requirement.

The lowest soluble content and residual monomer.

The highest durability and stability in the swelling environment and during the storage.

Colorlessness, and absolute non-toxic.

10.4 Properties of hydrogel :

Swelling properties : a small change in environmental condition may trigger fast and reversible changes in hydrogel. The alternation in environmental parameter like electric signal, pH, temperature and presence of enzyme or other ionic species may lead to a change in physical texture of the hydrogel.(21).

Mechanical properties : the mechanical properties can vary and be tuned depending on the purpose of the material. It is possible to obtain a gel with higher stiffness increasing the crosslinking degree or lowering it by heating the material. The changes in mechanical properties link to a wide range of variables and cause and different analysis must be made according to the material.(22).

Polymers used in hydrogel : hydrogel are prepared from natural and synthetic polymers.

Natural polymers: chitosan, gelatin, alginates, fibrin.

10.5 Classification of hydrogel products:

Natural hydrogel : natural hydrogels are biodegradable, biocompatible and good cell adhesion properties. These are two major types of natural polymer which are used to produce natural hydrogel are proteins such as collagen, gelatin and lysozyme, polysaccharides such as hyaluronic acid, alginate and chitosan.

Synthetic hydrogel : they are more useful as compare yo natural hydrogel because they can be engineered to have a much wider range of mechanical and chemical properties than their natural counter parts. Polyethylene glycol based hydrogel are one class of the widely used material in biomedical application due to their non-tixicity there compability and low immunogemicity.

Hybrid hydrogel : they are the combination of natural and synthetic polymer hydrogels. To combine the advantages of both synthetic and nautral hydrogels many naturally occurring biopolymers such as dextrin,collagen,chitosan,have been combined with synthetic polymer such as poly(n-isopropylacrylamide) and polyvinyl alcohol .(23)

10.6 Classification according to polymeric composition :

Homo-polymeric hydrogel : homo-polymeric hydrogels are referred to polymer network derived from a single species of a monomer , which is a structural unit comprising of any polymer network.

Co-polymeric hydrogel: co-polymeric hydrogel are comprised of two or more different monomer species with at least one hydrophilic component, arranged in a random , block or alternating confriguration along the chain of the polymer network.

Multi-polymer interpenetrating polymer hydrogel (IPN): an important class of hydrogel, having network system which is made of two independent cross-linked synthetic or natural polymer components. In semi-IPN hydrogel one component is a cross-linked polymer and other component is a non-cross-linked polymer.(24)

10.7 Classification based on type of cross – linking

hydrogel can be divided into two categories based on the chemical or physical nature of the cross-link junction.

Chemically cross-linked networks have permanent junction.

Physical networks have transient junction that arise from either polymer chain entanglement or physical interaction as hydrogen bond or hydrophobic interaction.

10.8 Classification based on physical apperance

hydrogel appearance as matrix , film or microsphere depend on the technique of polymerization involved in the prepration process.

10.9 Classification according to network electrical charge

hydrogel may be categorized into four groups on the basis of presence or absence of eletrical charge located on the cross linked chains:

Nonionic (neutral)

Ionic (including anionic cationic)

Amphoteric electrolyte (ampholytic) containing both acidic and basic groups.

Mechanism of action

- 1) curcumin hydrogel is applied topically to the affected area in psoriasis.
- 2) the hydrogel is absorbed into the skin and begins to release curcumin.
- 3) curcumin inhibits the activity of inflammatory cytokines such as IL-6 and TNF alpha
- 4) curcumin also inhibits the activity of enzymes involed in inflammation such as COX-2 and LOX .
- 5) by reducing inflammation curcumin may alleviate symptoms of psoriasis such as redness, scaling and itching .
- 6) curcumin may also promote wound healing by activating growth factor involved in tissue regeneration.
- 7) the sustained release of curcumin from the hydrogel provides prolonged exposure to the affected area .

XI. CONCLUSION

Curcumin hydrogel shows promise as a potential treatment for psoriasis , but further review , research is needed to establish its efficacy and safety . further studies should focus on optimizing the delivery system, determining the optimal dose and treatment duration and evaluating the long-term safety and efficacy of curcumin hydrogel. Additionally,more research is needed to understand the mechanism of action of curcumin in psoriasis treatment . in

conclusion curcumin hydrogel has emerged as a promising candidate for the treatment of psoriasis a chronic inflammatory skin disease . the potent anti-inflammatoy and antioxidant properties of curcumin make it a suitable agent for managing the symptoms of psoriasis including sacling ,eryhema and inflammation . the use of curcumin hydrogel can provided sustained release of curcumin atb the site of application ensuring effective treatment with minimal systemic side effect . furthermore the biocompatibility and the hydrogel make it a safe and effective topical therapy for curcumin hydrogel in treating psoriasis in human subjects. Nevertheless, the available preclinal evidence suggests that curcumin hydrogel holds great promise as a novel therapy for psoriasis .

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