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Review Article

A Review on Healing at the Surface: Exploring the Power of Antimicrobial Cream Formulation

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ABSTRACT

Creams have long been used as topical preparations due to their ease of application and removal from the skin. Pharmaceutical creams serve a wide range of purposes, from cosmetic uses such as cleansing, moisturizing, enhancing appearance, and beautifying, to therapeutic applications like protecting the skin against bacterial and fungal infections, and aiding in the healing of cuts, burns, and wounds [6]. Topical application offers several advantages over systemic therapy, including the ability to deliver high and sustained drug concentrations directly to the site of infection, reduced dosage requirements, improved patient compliance, fewer systemic side effects, and a potentially lower risk of developing antimicrobial resistance [8]. This review focuses on the use of topical drug delivery systems, specifically pharmaceutical creams, in wound healing. It provides a detailed discussion of the wound healing process, classification of creams based on their functions, their advantages and disadvantages, key characteristics, and the various types of creams available.[7].

INTRODUCTION

Topical drug delivery refers to the application of drug-containing formulations directly to the skin for the treatment of local skin conditions such as acne, wounds, or infections. This method can be divided into two categories. External topical formulations are applied directly to the skin's

surface by spraying, spreading, or dispersing. Internal topical formulations are applied to mucous membranes via oral, vaginal, or anorectal routes for local therapeutic effects. Topical drug delivery is particularly useful when other routes are unsuitable. It allows the drug to penetrate deeper skin layers, improving absorption and

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enhancing therapeutic efficacy. Compared to conventional dosage forms, topical systems offer several advantages, including fewer systemic side effects due to localized drug action and bypassing the gastrointestinal tract and hepatic metabolism. This leads to improved bioavailability and reduced GI irritation.^[1]

Topical Dosage Forms:

Topical drug formulations are broadly classified into:

1. Solid dosage forms: Dusting powders.
2. Semisolid dosage forms: Creams, ointments, gels, and pastes .
3. Liquid dosage forms: Lotions and linime.^[2]

Functions of Topical Formulations:

1. Hydrate the skin due to emollient properties.
2. Protect damaged or intact skin from external factors and assist in healing.
3. Deliver drugs directly to the skin for local therapeutic effects.^[2]

Advantages of Topical Drug Delivery:

1. Bypasses first-pass liver metabolism.
2. Simple and convenient to apply.
3. Enables targeted drug delivery at the desired site.
4. Avoids gastrointestinal disturbances.
5. Suitable for drugs with short half-lives or narrow therapeutic indices.
6. Improves patient compliance and supports self-medication.

Disadvantages of Topical Drug Delivery:

1. Limited skin permeability for certain drugs.
2. Drugs with large particle sizes may not be absorbed easily.
3. Potential for allergic skin reactions.
4. Ineffective for drugs that require high plasma concentrations.
5. Unsuitable for drugs that are irritating or sensitizing to the skin.^[3]

Creams: Definition and Overview

Creams are viscous semi-solid emulsions, either oil-in-water (O/W) or water-in-oil (W/O), used for topical application. They serve both cosmetic (e.g., beautifying, cleansing) and therapeutic purposes (e.g., treating dermatoses). Creams enhance drug penetration into the skin and are available in ayurvedic, herbal, and allopathic formulations.

They consist of one or more active ingredients dissolved or dispersed in a suitable base. Based on their emulsion type:

- O/W creams (e.g., vanishing cream) have oil droplets dispersed in water.
- W/O creams (e.g., cold cream) have water droplets dispersed in an oily phase.^[4]

Classification of Creams:

A. Based on Function:

1. Cleansing cream
2. Foundation cream
3. Massage cream
4. Protective cream



5. Night cream

6. Hand and body cream

B. Based on Emulsion Type:

1. O/W creams – e.g., vanishing and makeup creams

2. W/O creams – e.g., cold creams, moisturizing creams

Advantages of Creams as Drug Delivery Systems:

1. Easy and convenient for patients.
2. Avoids hepatic first-pass metabolism.
3. Suitable for rectal and vaginal applications.
4. High patient acceptance and compliance.
5. Allows quick discontinuation if needed.
6. Minimizes GI irritation.
7. Effective even with lower drug concentrations.

Disadvantages of Creams:

1. Some components may cause skin irritation or dermatitis.
2. Poor absorption of high molecular weight or lipophilic drugs.
3. Generally slower absorption rates.
4. Only suitable for drugs that require minimal systemic exposure.

Applications of Creams:

- Skin softening and moisturizing
- Cooling and soothing

- Anti-allergic and antiseptic effects

- Humectant and astringent properties

- Cleansing and protection

- Scabicial, anesthetic, and antifungal actions

- Fairness and anti-aging benefits

- Germicidal and parasiticidal effect.^[5]

Mechanism Of Action:

Antibiotics act through distinct mechanisms to selectively target and inhibit the growth of bacteria, fungi, and other microorganisms. Each antibiotic class interferes with specific cellular processes essential for microbial survival.

The most common mechanisms include:

1. Inhibition of Cell Wall Synthesis

Target: Bacterial cell wall

Examples: Penicillins, cephalosporins, vancomycin

Mechanism: These antibiotics disrupt the synthesis of peptidoglycan, a vital component of the bacterial cell wall. By inhibiting enzymes responsible for cell wall construction, they weaken the structural integrity of the cell wall, ultimately causing cell lysis and death.

2. Disruption of Protein Synthesis

Target: Bacterial ribosomes

Examples: Aminoglycosides, tetracyclines, macrolides

Mechanism: These antibiotics bind to bacterial ribosomes and interfere with protein production. Aminoglycosides cause misreading of mRNA,

tetracyclines block the attachment of aminoacyl-tRNA, and macrolides inhibit peptide chain elongation. These actions collectively halt protein synthesis, impairing bacterial growth and function.

4. Disruption of Cell Membrane Function

Target: Bacterial cell membrane

Examples: Polymyxins

Mechanism: Polymyxins bind to components of the bacterial cell membrane, disrupting the lipid bilayer structure. This disruption increases membrane permeability, causing leakage of essential intracellular contents and ultimately leading to cell death. Polymyxins are especially effective against Gram-negative bacteria due to their unique outer membrane composition.

5. Interference with Metabolic Pathways

Target: Bacterial folic acid synthesis

Examples: Sulfonamides, trimethoprim

Mechanism: Sulfonamides and trimethoprim inhibit key enzymes in the folic acid synthesis pathway—dihydropteroate synthase and dihydrofolate reductase, respectively. Since folic acid is essential for the synthesis of nucleic acids, blocking its production impairs DNA and RNA formation, thereby halting bacterial growth and replication.

Target: DNA or RNA synthesis in bacteria

Examples: Fluoroquinolones, rifampin

Mechanism: Fluoroquinolones inhibit DNA gyrase and topoisomerase IV, enzymes essential for DNA replication and repair. Rifampin blocks bacterial RNA polymerase, preventing RNA transcription. By interfering with nucleic acid

synthesis, these antibiotics disrupt the replication and transcription processes, ultimately stopping bacterial proliferation.^[6]

Wound And Wound Healing Process:

A wound is defined as a disruption or break in the anatomical, functional, or cellular continuity of the skin or underlying tissues. Wounds can result from various causes, including physical, chemical, thermal, microbial, viral, immunological trauma, or violence.

Wounds can be broadly classified based on the mode of injury and the causative agent:

1. Closed wounds – e.g., contusions, closed fractures.
2. Open wounds – including:
 - a) Sharp cuts
 - b) Lacerations
 - c) Abrasions
 - d) Avulsions
 - e) Crush injuries
 - f) Puncture wounds
 - g) Bite wounds
 - h) Burn wounds

Wound healing is a complex biological process that involves the contraction and migration of cells, re-adhesion of tissues, and tissue regeneration following injury. This process includes several stages such as platelet aggregation, blood clot formation, fibrin deposition, inflammatory response, changes in extracellular matrix components, angiogenesis (formation of new blood vessels), and re-epithelialization (restoration of the skin surface). The healing is considered complete only when the disrupted tissues are effectively repaired by collagen deposition and finalized with scar formation.^[7]

CONCLUSION:

The skin, being the most accessible organ of the body, is also highly susceptible to injuries. In cases of cuts, burns, and wounds, topical formulations—particularly creams—are commonly preferred for treatment. Compared to conventional delivery systems, topical formulations offer several advantages, such as ease of application, reduced risk of systemic side effects, a non-invasive approach, and improved patient compliance. In recent decades, research and development in the formulation of pharmaceutical creams for wound healing has significantly advanced due to these benefits. With ongoing progress in the pharmaceutical sciences and industry, pharmaceutical creams are expected to remain a promising and dynamic area of research in the foreseeable future.^[7]

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