AN OVERVIEW OF PHARMACEUTICAL CREAMS – A REVIEW

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***Abstract*- Pharmaceutical creams are topical preparations commonly used in various types of skin treatment conditions like, inflammation, infections, pain and dryness. Most typically consisting a combination of water and oil, these emulsions can be designed to the skin in order to deliver active ingredients, and allowing for the localized treatment with minimal systemic absorption. Usage of a cream will keep the skin looking youthful while also protecting and softening it. It makes sense to employ the hand lotions that include a lot of oil, because our fingers and palms requires it to keep from drying out and splitting. Among the earliest areas to exhibit aging symptoms is the hands. We frequently wash our hands throughout the day in an effort to the moisture. Compared to other body parts, the hands receive the most use. The cream effectiveness would depends upon the formulation, the active ingredients concentration, and the type of condition the cream should be treated. Although the cream should be safe and improper usage or application on the skin will cause skin irritation, thinning, or allergic reactions. With advancements in drug delivery systems, personalized skin care, and enhanced formulations, the future of pharmaceutical creams hold great purpose in improving treatment outcomes and offering more tailored solutions for patients.**

***Index Terms*- Creams, localized treatment, systemic absorption, enhanced formulations.**

I. INTRODUCTION

Pharmaceutical creams are semisolid dosage forms, containing one or more drug substances dissolved or dispersed in a suitable base, intended for external application to the skin or mucous membranes. They are used for topical delivery of medications and can be either oil-in-water or water-in-oil emulsions. The Pharmaceutical creams are oil-and-water semi-solid emulsions and are therefore most frequently used. Instead of being applied in the form of ointments or gels, since, they have an excellent balance of consistency that facilitates our simple application to the skin and their absorption without leaving behind oily smudges. The creams, in general a combination of mixture of water, oils, emulsifiers, preservatives, and active compounds altogether that assist in the absorption of medicine while at the same time helping to provide moisturization. These products are used to treat both dermatological diseases and systemic illnesses that may be affected by applying creams on the skin.[1]

This is the most significant class of topical dosage forms of pharmaceutical creams with number of applications with therapeutic areas like

a) Dermatology
b) Pain management
c) Hormone therapy
d) Anti-inflammatory treatments

They can be hydrophilic (Water-based), lipophilic (Oil-based), and more complex emulsions depending on the characteristics of the active ingredient and the desired effect. The main reason why creams have become the popular topical preparation compared to ointments or gels is because of their flexibility, offering therapeutic and cosmetic benefits which is suitable for sensitive skin and featuring a variety of medical conditions.[2] In many situations, creams serves as a face cleanser. The pharmaceutical purpose of a cream is to deposit its active ingredients locally at where the action is taking place with minimal systemic absorption. This makes them best and suited for diseases, where localized therapy is needed like eczema, psoriasis, fungal infection, and also chronic diseases, such as arthritis or muscle pain, apart from this, topical creams are also popular in treatments that replace hormones, which are applied especially on the skin for steroids or other hormones through topical application instead of oral medication. An advantage that the application of pharmaceutical creams enjoys over the oral intake of orally given drugs are found in the fact that, while any such medical condition mainly affects the skin, the drug is applied locally with direct action on the specific area involved and thus less chances of systemic side effects. In addition, in its preparation, such creams usually contain moisturizers and safeguard the integrity of the skin. Some creams use formulae and allow the prolonged release, so the active ingredients are released gradually, and exhibit an extended pharmacological action with fewer applications. Cosmetics are significant because they can approve one's image in today's world. The need for individuals to shield their skin and

themselves from the sun's rays has been exploited by numerous producers of cosme tics. For rough, dry and cracked skin the cosmetic creams are considered a food. Its major functions are to soften, lubricate, and cleanse the skin of undesirable debris. Among the most often used fat creams are lanolin and Vaseline. Many creams now contain controlled release or sustained release mechanisms that release the active ingredients gradually over time. Gelatin, which serves as a foundation for the skin and soap both are made by using dry creams. The need for pharmaceutical creams is raising daily in India because of the reasons behind this growth, like urbanization, increase in health awareness, and the disposable income level [4]. In most of the areas in India, the traditional remedies are being used sometimes with the pharmaceutical cream or even at times in its place. The Ayurvedic products are mainly searched for as natural products and hence perceived to be safer. As the pharmaceutical cream market expands, challenges like counterfeit products and overuse need to be addressed to ensure that these creams are used safely and effectively across the globe. The creams usage can be divided into geographical, cultural and medical usage [5].

II. HISTORY OF PHARMACEUTICAL CREAMS

Creams have been used to heal skin for thousands of years, the first formulation were prepared using oily bases like petroleum jelly and lard. In the ancient Greek and roman, the early ointment formulas were created by Greek and roman physicians, including Hippocrates and Galen, employing fats, oils, and plant extracts.

17th & 18th centuries: - The chemistry and medicine was so advanced in 17th century, the creams became increasingly sophisticated. And with the discovery of glycerine and other stabilizing ingredients in the 18th century, topical treatments became smoother and more durable.

19th century: - The pharmaceutical creams were standardized by the 19th century as modern chemistry and pharmacology emerged.

20th century: - The term "cosmeceuticals" which combines the words "cosmetics" and "pharmaceuticals", initially utilized in the latter half of the 20th century to describe goods that combine active components with cosmetic advantages.

21st century: - Since the development of nanotechnology, pharmaceutical creams have used nanoencapsulation technology, which enables active substances to more precisely target skin cells and penetrate deeper into the skin.

III. ADVANTAGES OF PHARMACEUTICAL CREAMS

- The creams can absorb into the skin quickly because they are water based, and delivers the active ingredients without leaving any sticky residue. The creams are easily applied and spreads evenly on the skin.
- The localized action of the cream is tend to act mostly on the skin, where they are applied, minimizing side effects as compared to oral drugs.
- The moisturizing ingredients in cream formulation, will help to hydrate the dry, damaged (or) sensitive skin and also it helps to restore the skin natural barrier function.
- In contrast to ointments, the creams can be heavier and more oil-based and it can tend to cause less irritating on skin.
- Creams are flexible choices for combination therapy since they can frequently be used in conjunction with other drugs or therapies.
- Since creams are typically less susceptible to microbiological contamination and the creams are more durable than liquid formulations.
- The topical creams are only slightly absorbed via the skin, they usually carry a lower risk of systemic adverse effects and allergic responses. For those who are likely to stomach problems (or) who are sensitive to oral medications, this makes them a good choice.
- The creams are formulated to be cosmetically appealing with pleasure textures and fragrances.
- The targeted delivery of the drug can be formulated to deliver medication to several layers to the skin.
- Wide range of formulations available to suit different skin conditions and drug delivery needs.
- To overcome some chronic conditions like dermatitis, acne and certain fungal infections, the usage of pharmaceutical creams will help to play a crucial role to allow for ongoing treatment without any need of invasive procedures.
- In customizable formulations, Certain medicinal creams which can be compounded in pharmacies, enables an inclusion of extra ingredients for certain effects or modifying the strength of the active ingredients to meet individual needs.

IV. IDEAL CHARACTERISTICS OF PHARMACEUTICAL CREAMS

- The physical stability of a cream must maintain good uniform consistency, viscosity, and appearance over

shelf life and avoid the phase separation, cracking, or hardening.

- The chemical stability of the active ingredient should retain its potency and therapeutic efficacy throughout its shelf life.
- Doesn't trigger an allergic reaction in patients.
- pH should be close to physiological skin pH (around 5.5) for optimal comfort and to minimize disruption of the skin's natural barrier.
- To identify the efficacy of drug release, the Controlled release of the active ingredient for optimal therapeutic effect. The Adequate penetration into the skin to reach the target site of action.
- The appearance of the cream should be smooth, homogeneous texture and a visually appealing colour. The Acceptable Odor of the cream is mild or pleasant fragrance, or odourless.
- The cream should be compatible and choose a container for stable packaging (in a tube, jar, etc).
- It is Efficient and cost-effective manufacturing process.A well-established safety profile indicates that the cream is free of dangerous substances (such parabens or specific preservatives) and can be applied for extended periods of time as needed.

V. TYPES OF PHARMACEUTICAL CREAMS

Semi-solid dosage forms used topically to the skin are called pharmaceutical creams. They are emulsions, which are made up of two immiscible liquids (water and oil) together with the aid of an emulsifier. The medicinal creams are come in two primary varieties.

- **Oil-in-water (O/W) creams:** In these creams, small droplets of oil are dispersed in a continuous water phase. Compared to water-in-oil creams, they are typically lighter, less oily and easier to apply. Additionally, they are simpler to remove with water.
- **Water-in-oil (W/O) creams:** These creams contain a continuous oil phase with tiny water droplets scattered throughout. Compared to oil-in-water creams, they are typically more occlusive and oilier. They are frequently applied to shield the skin against dehydration.

The usage of cream type will depend on the specific condition being treated and the desired effect. For example, oil-in-water creams are used for acne and other oily skin conditions, while water-in-oil creams are used for dry skin conditions.[10]

VI. CLASSIFICATION OF CREAMS[11]

Every form of skin cream can be categorized according to many criteria, such as the type of emulsion, its nature, its function, and its characteristic qualities. The kinds of creams based on their purpose, unique qualities, and emulsion type;

i. **Make-up cream**: - These are mostly O/W emulsions. This cream-based product leaves the skin with a moisturized, silky finish that can be either bright or stain matte. It gives skin nourishment, a dewy gloss, and essentially resists perspiration.[13]

Examples: - Garnier SkinActive BB Cream, Laura Mercier Tinted Moisturizer

ii. **Vanishing creams**: The reason they named vanishing creams is because they seem to disappear when applied to the skin. These formulations are based on stearic acid. After use, the cream dries out the skin by leaving behind a sticky dry residue. Hence, these are utilized particularly in warmer regions where perspiration transpires on the skin. **Examples:** - Pond's Vanishing Cream, Nivea Soft Moisturizing Cream, Nivea Soft Moisturizing Cream, Vaseline Intensive Care Advanced Repair Unscented Lotion

iii. **Cleansing creams:** The use of washing lotions or creams to remove oil, surface, dirt, and makeup from the face and neck is essential for cosmetics, but these creams are also used for personal hygiene and beauty in addition to body cleaning. **Examples:** - Garnier SkinActive Gentle Sulfate-Free Cleanser, Kiehl's Ultra Facial Cleanser.

iv. **Moisturizing creams:** These formulations are w/o, meaning that the proportion of oil to water will be higher. It is referred to as a moisturizer or moisturizing cream. Emollient action is required from cold cream. It ought to feel cool when applied and the skin's oil layer shouldn't get away.

Example: - La Roche-Posay Lipikar Balm

v. **All-purpose creams and general creams:** More people than ever before are using these creams nowadays. Having a slightly fatty but non greasy texture, these creams are easily applied to the skin. Aside from treating roughened skin areas, these can also be used as a night cream or protective cream to prevent sunburns.

Examples: - Nivea Crème, Vaseline Petroleum Jelly, Brightening Night Cream by L'Oréal Paris Revita lift Bright Reveal.

VII. COMMON INGREDIENTS FOR SKIN CREAMS

The ingredients that are used to prepare skin creams are as follows

a) **Water :-** water is a component of all cream compositions. Water is used as a solvent to dissolve

other ingredients in skin treatments. It is free of toxins, pollutants, and microbes, and other contaminants are used to manufacture a cream. Water can also produce emulsions, depending on how much it is involved in the composition. These are also called water-in-oil emulsions or oil-in-water emulsions, depending on the amounts of water and oil phases employed.[15]

b) **Oils: -** It is a necessary component of creams. Depending on their purpose, waxes serve as emulsifiers, fats as thickeners, and oils as preservatives, fragrances, etc. Two types of oils :-

i. **Mineral oil: -** The hydrocarbons that make up this substance are taken from petroleum oil. A typical ingredient in cosmetics, mineral oil is highly refined odourless and transparent. Mineral oil rarely causes allergic reactions and doesn't stick to the skin or clog its pores. It is lightweight, reasonably priced, and helps to stop water loss while keeping the body hydrated. A range of mineral oils are used in formulation.

Examples :- liquid petroleum, heavy liquid paraffin, and light liquid paraffin.

ii. **Vegetable oil: -** It helps to keep skin plump by forming a barrier on the skin's surface and reducing water loss. Additionally, the lipid or oil component of creams or other personal care products can be thickened by using vegetable oils, for instance sunflower oil, avocado oil, germ oil, almond oil etc.

c) **Waxes: -** Cream is made from ceresin, spermaceti, beeswax, carnauba wax, and other waxes. Because they keep the liquid and oil components of an emulsion from separating, waxes are used in cosmetics. Furthermore, these waxes cause the lipid portion and sticks to thicken.

d) **Fats: -** Glycerides, oils and fats are made up of glycerine and higher fatty acid combinations and can come from either vegetable or animal sources. Depending upon the method they can be saponified to produce soap, fatty acid or glycerine. Laurentic, margaric, palmitic, steric and saturated groups are the most prevalent of these fatty acids. The most common unsaturated fatty acid is oleic acid, which is liquid more specifically, mutton tallow, yard, peanut oil, almond oil, seasame oil, olive oil and beef stearine are the oils most frequently found in other cosmetics.[17]

e) **Colours :-** Pharmaceutical cream colours are usually chosen with care to guarantee their safety, usefulness, and aesthetic appeal. They must be widely accepted as safe for topical use and non-toxic and non-sensitizing. The colours can be made from natural or synthetic substances. It may be applied as a tablet core or film coating on the core. Natural colours used for pharmaceutical creams include beetroot, turmeric, curcumin, saffron and non-synthetics like caramel, anthocyanins are pigments used as colours for pharmaceutical creams.

f) **Emollients: -** It helps to soothe or moisturize the dry skin are called emollients. They are commonly referred as moisturizers. Emollients are primarily oil or grease products, including lanolin, mineral oil and squalene. Applying oil and lubricating the skin to stop water loss improves the skin ability to hold onto water.[19]

g) **Humectants: -** Most skin care products contain these crucial, multipurpose components. The chemical molecules known as humectants are hydroscopic. Moisture can be absorbed and retained by these materials. These offer numerous advantages, including exfoliation and moisturization. Glycerine, hydroxyethyl urea, betaine, sodium PCA, sodium-L-lactate, and others are examples for humectants.[20]

h) Perfumes: It's a chemical that gives things a smell, such as a pleasant and sweet one. Examples of natural fragrances found in creams include orange blossom, rosy dreams, and white blossom**.**[21]

i) **Vitamins:** The preservation of the skin's and the body's overall physiological function depends on it. Vitamins A, B, C, E, and others are generally used, when making creams.

j) Preservatives: To prevent contamination and microbiological alterations throughout formulation, shipping, storage, and consumer usage, cosmetics must contain preservatives. Antioxidants are also used to stop the alterations that come from being exposed to oxygen.[22]

VIII. BASES USED FOR CREAMS[19]

Bases are act as the active ingredients' vehicle or foundation. The base ensures the cream has suitable stability, compatibility with active ingredients, helps to deliver the active pharmaceutical ingredient (API) to skin and to control the viscosity by making the cream easy to apply without being too thick. Creams are generally prepared with a number of bases, its own characteristic properties;

1. **Oleaginous Bases:** These are composed of oils and fats, providing a greasy, occlusive feel. Its excellent in protecting the skin and preventing moisture loss. Examples include: Petrolatum (Vaseline) - A common, inexpensive base that is chemically inert and provides good emollience.

Mineral oil - A lightweight, non-greasy oil that is often used in combination with other bases.

2. **Absorption Bases:** These bases are made with can absorb water and form a water-in-oil emulsion. They are useful for adding aqueous solutions to the cream. Examples include: Anhydrous Lanolin: A natural animal wax which can absorb a quite a lot of water. Hydrophilic Petrolatum: A modified form of petrolatum which can absorb water.
3. **Water-in-Oil (W/O) Emulsion Bases:** These bases are made with fine water droplets dispersed in oil phase. Hence W/O emulsion bases are greasier compared to O/W cream and have a high emollience. Cold cream, a well-known W/O base, comprising beeswax and spermaceti, along with rose water. Lanolin, a natural animal wax having good emulsifying properties for W/O emulsions.
4. **Emulsion of Oil-in-Water (O/W) Bases:** These bases contain small oil droplets dispersed in a water phase. They are lighter, less greasy, and easier to wash off than W/O creams. Examples include: Vanishing Creams: These creams contain stearic acid and other emulsifiers that create a light, non-greasy feel. Lotions**:** These are typically lighter than creams and contain a higher proportion of water. [20]
5. **Alcohol Based:** - The preparation of topical creams that uses alcohol as a primary ingredient or solvent- usually in the form of ethanol or isopropyl alcohol- is known as the alcohol-based approach in medicinal creams. This method is frequently used in dermatological treatments where alcohol is crucial for improving absorption, solubilizing active pharmaceutical ingredients (APIs), or offering certain therapeutic advantages including rapid drying or antibacterial qualities.

The selection of a base depends on various factors, including the desired properties of the cream, the nature of the active ingredient, and the intended use. if the cream is intended to be easily washed off, an O/W emulsion base would be preferred. If the primary goal is to skin protection and prevent moisture oss, an oleaginous or W/O emulsion base would be more suitable.

IX. PREPARATION OF PHARMACEUTICAL CREAMS

Creams are semi-solid dosage forms containing more medicinal agents scattered or dissolved in an appropriate base. Some Strict parameters are followed in formulation of these creams to guarantee their safety, stability, and effectiveness. In order to produce an emulsion, which enables the cream to apply its therapeutic benefits directly to the skin, several ingredients must be carefully blended during the manufacturing process. Pharmaceutical cream preparation involves in mixing active chemicals with different excipients to produce a product that is stable, efficacious, and appropriate for topical use. Some dosage forms contain active components intended to treat medical disorders including eczema, acne, fungal infections, or inflammation, pharmaceutical creams vary from cosmetic creams. The correct transport of the active ingredient to the skin, improved user experience, and safety are all guaranteed by a well-balanced cream composition. It applied externally for their local effect. The pharmaceutical cream preparation typically involves the following steps:

Preparation of Phases: The manufacturing process of creams typically involves the preparation of two primary phases: the oil phase and the water phase. Both phases are mixed together to form an emulsion.

Oil phase preparation: -

- The oil phase, which frequently contains oils, waxes, or butters, is supplemented with emulsifiers and oil-soluble excipients.
- The oil phase dissolves the lipophilic (oil-soluble) API.
- After that, the oil phase is heated (usually to 70–75°C) to guarantee that all of the ingredients melt and dissolve completely.

Water phase preparation: -

- The water phase combines water-soluble excipients, including water, glycerine, and any hydrophilic APIs (such as corticosteroids or antibiotics).
- To guarantee the materials' solubility and uniformity, the water phase is likewise heated to the same temperature (70–75°C).

Most important methods to create pharmaceutical creams are listed below;

a) Hot process (fusion method): - Among the most often used methods for producing pharmaceutical creams, particularly emulsions, is the hot process, sometimes referred to as the fusing method. The water and oil phases are heated independently before being combined under carefully monitored circumstances.

- Depending on the formulation, the oil-soluble components—such as emulsifiers (like cetyl alcohol and stearyl alcohol), oils (including mineral and vegetable oils), and lipophilic APIs (active compounds that dissolve in oil)—are heated to between 70 and 75°C.
- To guarantee that all phases have the same consistency, the water-soluble components—such as water, hydrophilic active substances, and gelling

agents—are heated independently to a comparable temperature.

- To make an emulsion, the hot oil phase is gradually introduced to the water phase while being constantly stirred. In order to keep the water and oil phases from separating, the emulsifiers aid in creating a stable contact between them.
- Following room temperature cooling, the emulsion is gently stirred to preserve homogeneity and avoid crystallization or separation.
- Heat-sensitive components, such perfumes, preservatives, or certain vitamins (like C and E), can be added following the cream has cooled.

b) Cold process (cold emulsification method):- When the temperature of some sensitive components are utilized in formulation or when heating could damage some active compounds, the cold process approach is employed. Usually, this technique makes use of emulsifiers that function well at lower temperatures.

- Glycerin, preservatives, and hydrating agents are the water-soluble substances, they combined with cold water to obtain the water phase at ambient temperature.
- Emollients, emulsifiers, and lipophilic active substances are oil-soluble components that are distributed in a tiny quantity of an oil phase that is also at room temperature to get a oil phase.
- Using a high-speed homogenizer or shear mixer, gradually introduce the oil phase to the water phase while being constantly stirred or mixed. And it is known as emulsification.
- Any heat-sensitive components (such proteins, vitamins, or antioxidants) are added last after the emulsion has formed in order to avoid heat-induced breakdown.

c) High shear mixing (homogenization):- When emulsions call for stable, fine dispersions of the oil droplets in the water phase, high shear mixing is frequently employed. This technique breaks down bigger oil droplets and produces a smooth, stable cream by using a high-shear mixer or homogenizer.

- The two phases (water and oil) are made independently, just like in the hot or cold process.
- When the phases are prepared, a homogenizer is applied to a strong shear pressures to the combination after oil phase has been added to water phase. By reducing the size of the oil droplets, this technique improves the cream's stability and encourages a uniform distribution.
- If required, the cream is allowed to cool before any necessary texture and consistency modifications are made.

d) solvent evaporation method:- Creams with volatile solvents or those with an alcohol basis are made using the solvent evaporation method. This technique is frequently used when the active ingredient needs to dissolve in a solvent (like alcohol) that can evaporate, leaving behind a cream that has active ingredient dispersed evenly.

- When the temperature is at room temperature, the active medicinal component is disintegrated in an appropriate solvent (such as ethanol or isopropyl alcohol).
- The desired emulsifying agents, water, and oil phases are used to create the cream base.
- To ensure even distribution, the solvent containing the dissolved active component gradually added to the prepared cream base.
- In order to allow the solvent to evaporate and leave the API in the cream matrix, the cream is subsequently put under regulated circumstances or put under a vacuum.

e) Emulsification by ultrasonic method: - The ultrasonic emulsification process breaks down and shrinks oil droplets by using ultrasonic waves to form emulsions. When working with fine emulsions that require smaller droplet sizes, this high-energy method is employed.

- As with conventional techniques, the water and oil ph ases are made independently.
- After combining the two phases, the mixture is subje cted to ultrasonic waves.
- A fine, stable emulsion results from the enormous sh ear pressures produced by

the sound waves, which shatter the oil droplets into ext remely tiny pieces.

- Any delicate ingredients are added once the emulsific ation process is finished and the cream has cooled.

f) Spray drying method :- The spray drying method is used primarily for solid formulations, but it can also be adapted for creams where an active ingredient needs to be encapsulated or dispersed in a cream matrix. The chemicals that are active and combined with a suitable carrier and then spray-dried to form a powder, it is integrated into the cream.

- A carrier, like starch or polymer, is combined with the active medicinal component and dissolved in an appropriate solvent.
- Following atomization of the solution in a spray drier, rapid evaporation of the solvent leaves behind, tiny particles that are subsequently combined with the cream base.
- After the powder is added to the cream, it is properly mixed and stabilized**.**

X. QUALITY CONTROL

A crucial step in the production of medicinal creams is quality control (QC) testing. These tests are intended to guarantee the final product's stability, safety, and effectiveness while adhering to legal requirements. Pharmaceutical creams must adhere to a number of quality standards, including medication potency, microbiological content, consistency, texture, and appearance. Few key quality control tests typically performed on pharmaceutical creams.

10.1 Drug content assay: - To guarantee that the cream contains the active pharmaceutical ingredient (API) in the proper amount and that it is dispersed uniformly throughout the product. The acceptance standards for each batch's active component content should fall within the ranges listed in the product's formulation, which is typically ±10% of the content that is labeled.

10.2 Microbial Testing: - To evaluate the cream's microbiological safety and make sure it doesn't include any dangerous microbes that could lead to infections or undermine the effectiveness of the product. No hazardous concentrations of pathogenic bacteria should be present in the cream. Over the course of the product's shelf life, the preservatives ought to be successful in preserving its microbiological integrity. These are the acceptance standards of microbial testing.

Tests Performed:

- The Total microbial count indicates the product's total microbial load.
- Tests for particular bacteria, including *Salmonella, Escherichia coli, Pseudomonas aeruginosa and yeast/Mold.*
- The Preservative efficacy test verifies that the formulation's preservatives are capable of inhibiting microbiological growth over time.

10.3 Stability Testing: - To assess the cream's stability over time in terms of its physical, chemical, and microbiological properties. Stability testing guarantees that the product will remain safe and effective for the duration of its shelf life. Throughout its anticipated shelf life (e.g., 1-2 years), the cream should maintain consistency in terms of appearance, medication content, and microbiological safety. There shouldn't be any major viscosity changes, phase separation, or loss of API efficacy**. Method:** a number of environmental elements, such as temperature (e.g., 25°C, 40°C), humidity, and light exposure, are applied to the cream.

To estimate the product's shelf life, accelerated stability testing is also carried out (for example, at greater temperatures).

10.4 Heavy metal testing:- To guarantee that the cream is free of dangerously high concentrations of potentially poisonous heavy metals as lead, arsenic, mercury, or cadmium. The cream must not surpass the jurisdiction-specific regulatory limitations for heavy metal contamination. **Method:** The presence of heavy metals in the cream is identified and measured by using Atomic Absorption Spectroscopy (AAS)

10.5 Rheological Properties testing: - The goal is to assess the cream's texture and flow characteristics to make sure it is easy to apply and has the right consistency. The cream should exhibit suitable shear-thinning behaviour, which means that pressure makes it easier to spread and that it later regains its thickness.

XI. EVALUATION PARAMETERS OF PHARMACEUTICAL CREAMS

Assessing medicinal creams is essential to guaranteeing their efficacy, safety, and quality. The assessment procedure aids in verifying that the cream is safe for consumer use and achieves the desired therapeutic effects. The following are the main criteria used to evaluate medicinal creams:

11.1. Determination of pH :- By taking a sufficient amount of the formulation diluted with an appropriate solvent in a suitable beaker, the pH of the cream can be determined by room temperature using a standard digital pH meter. Sensitive skin has a pH between 4.5 to 5.5, which is mildly acidic.

11.2 Physical appearance: - The cream’s color, roughness, and grading all reveal its physical characteristics.

11.3 Spreadability: - Adequate amount of a sample is placed between two glass slides, and for five minutes, a 100 mg weight is placed on the slides. The formula for spreadability is S=m*I/t. where ‘m’ is weight on the upper slide, ‘I’ is distance travelled on the glass slide, ‘t’ is amount of time.

11.4 Saponification value:- Note the reading as "a" after refluxing 2 grams of the material with 25 millilitres of alcoholic KOH at 0.5 N for 30 minutes. Immediately after, 1 millilitres was added and the phenolphthalein is titrated using with 0.5 N HCl. Repeat the process without the material being inspected. Value of saponification = (b-a)*28.05/w, where w is the substance's weight in grams, is the reading to be noted.

11.5 Acid value: 50ml of a properly weighed mixture of solvent ether and alcohol is utilized to dissolve 10g of the substance. The sample is dissolved entirely by gently heating the flask, which is attached to a reflux condenser. The liquid is then 0.1 NaOH titration followed by 1 ml of phenolphthalein, and after 30 seconds of shaking, a subtle pink hue emerges. n * 5.61 w is the acid value.

The millilitres of 0.1 N KOH solution are denoted by 'n' , w = material weight in grams.

11.6. Viscosity: viscosity can be measured using Brookfield viscometer for cream formulations. Generally speaking, cream viscosities vary from 10,000 to 50,000 centipoise (cP), depending on whether they are thick or light formulations.

11.7. Homogeneity: Visual appearance and tactile testing were used to assess the homogeneity of the formulation.

11.8. Removal: By rinsing the area where the creams were applied with tap water, the creams' ease of removal was assessed.

11.9. Irritancy study: Mark a 1 square centimeter spot on the dorsal surface of the left hand. After applying the cream on an area, the time was recorded. Continually for a maximum of 24 hours, any irritability, erythema, or edema was assessed and reported**.**

XII DISADVANTAGES OF PHARMACEUTICAL CREAMS

- Some medications might not reach the skin deeply to accomplish the desired therapeutic effect.
- Some ingredients in creams can cause skin irritation or allergic reactions in certain individuals.
- sometimes be messy to apply and may stain clothing.
- It may not be stable for extended periods of time, particularly when to heat or light.The rate and extent of drug absorption can vary depending on factors such as skin condition, hair growth, and application site.

XIII FUTURE ADVANCEMENTS IN PHARMACEUTICAL CREAMS

These advancements have the potential to revolutionize the field of topical drug delivery, leading to more effective, targeted, and personalized treatments for a variety of skin conditions ; [32] Incorporating nanoparticles into creams can improve drug solubility, stability, and targeted delivery to specific skin layers.[33]. These carrier systems can encapsulate drugs and enhance their penetration and retention in the skin. Personalized 3D-printed creams could allow for customized drug delivery and improved patient adherence.[34]. Combining creams with digital technologies (e.g., sensors, apps) to monitor drug delivery, track patient adherence, and provide personalized feedback.[38]. Utilizing AI to optimize cream formulations, predict drug interactions, and personalize treatment plans.[37]

XIV CONCLUSION

Pharmaceutical creams have the advantages of ease of application, targeted action, and relatively minimal systemic absorption, thus reducing the risk of systemic side effects. Such creams are invaluable in managing acute and chronic conditions, which improves patient outcomes when applied appropriately. Ongoing advancements in formulation and drug delivery will probably expand the efficacy and variety of pharmaceutical creams, offering more specialized treatment options for diverse medical needs.

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