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A Comprehensive Review on the Formulation, Characterization, and Evaluation of Lactic Acid-based Moisturizing Cream

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Abstract

This research intends to formulate a moisturizing cream that enhances skin hydration, whilst contributing to maintenance of the skin's natural barrier function. The three main types of agents that comprise moisturizing agents are humectants,

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emollients, and occlusives; these work together to occlude skin moisture and prevent excessive loss of moisture. The suggested formulation suggests ment to consist of glycerin, aloe vera, rose water, beeswax, neem oil, and borax due to it complementary properties in enhancing hydration and maintaining skin's lipid balance. Adjunctive agents include panthenol and allantoin which help to manage discomfort and improve texture. Overall, this research demonstrates how a balanced cream formulation plays an important role in developing better daily skin care practices, reducing transepidermal water loss (TEWL), and accelerating skin healing.

Keywords: Aloe vera, Lactic acid, Moisturizing cream, Neem oil, Skin hydration.

1. INTRODUCTION

Cosmetic formulations are mostly used to help clean the skin and enhance its appearance. The term "cosmetic" is derived from the Greek word kosmesticos, which means "to adorn," (Yadav et al., 2023) Ancient Rome is where the name "cosmetic" originated, as these products were widely used for personal care and beauty.

According to standard definitions, cosmetics are preparations applied to the human body—by rubbing, pouring, or spraying—to cleanse, enhance attractiveness, or modify appearance. In Roman culture, these products were often prepared by attendants known as cosmetae and their primary purpose was to improve physical appeal (Jeevitha & Mariyappan, 2023).

1.1. *Cream*

One or more active or supporting substances are either dissolved or evenly distributed inside a base to create creams, which are semi-solid dosage forms. Usually made as water-in-oil (W/O) or oil-in-water (O/W) emulsions, they can also infrequently be made in other washable bases that can be applied topically. (Narayanan et al., 2023).

The primary functions of creams include cleansing the skin, enhancing appearance, providing protection, and serving therapeutic purposes in dermatological care.

1.1.1. *Types of cream*

Creams are broadly classified into two main categories:

1. **Oil-in-Water (O/W) creams**
   These are emulsions where a continuous water phase has oil droplets scattered throughout it. In general, they are non-greasy, light, and simple to apply to the skin.
2. **Water-in-Oil (W/O) creams**
   In this type, water droplets are dispersed within an oil phase. Such creams are thicker, provide stronger occlusion, and are more suitable for dry or damaged skin. (Petare et al., 2024)

1.1.2. *Ideal Characteristics of Face Creams*

An effective facial cream should possess the following qualities:

- Be simple to apply and spread uniformly over the skin.
- Have a pleasant appearance and texture.
- Cause minimal irritation or allergic response.
- Melt or liquefy easily at body temperature.
- Promote a mild flushing effect and open skin pores.
- Form a thin emollient layer on the surface after application.
- Prevent excessive dryness that often follows frequent washing with soap or water.
- Contribute to skin softening, lubrication, protection, and overall cleansing benefits. (Bhavani et al., 2023)

1.1.3. *Classification of Creams*

Skin creams can be grouped in several ways, depending on their intended use, physical characteristics, and the type of emulsion employed in the formulation.

- Based on function: These include products such as cleansing creams, foundation creams, massage creams, and protective creams.
- According to characteristic properties: Examples are cold creams, vanishing creams, and similar specialized products.
- Based on the type of emulsion: Creams may be oil-in-water (O/W) or water-in-oil (W/O), which influences their feel and application.

1.1.4. *Examples of Cream Types*

- **Make-up preparations (O/W emulsions)**: such as vanishing creams and foundation creams.
- **Cleansing formulations (W/O emulsions)**: including cleansing creams, cleansing milk, and cleansing lotions.
- **Winter-care products (W/O emulsions)**: such as cold creams or moisturizing creams.
- Multi-purpose creams: including general-use and all-purpose formulations.
- Night and massage creams.
- Skin-protective creams.
- Hand and body creams. (Ashtul et al., 2023)

1.1.4.1 Make-up cream

This type of cream is generally formulated as an oil-in-water (O/W) emulsion. It provides a smooth and hydrated finish to the skin, which may appear matte, satin, or lightly glossy. These creams provide the skin with nourishment, sweat resistance, and a bright, natural shine (Ashtul et al., 2023).

1.1.4.2 Vanishing creams

The term vanishing creams may be used because, once the cream has been applied and rubbed into the skin, it seems to disappear. Stearic acid is usually made into a base for the product. The product is then designed to leave just a thin layer on the skin, which may have a somewhat dry feel and is a good alternative to reducing oiliness. Because of that feature, vanishing creams also tend to be helpful in hot, humid climates where perspiring is common (Ashtul et al., 2023).

- **Foundation Cream**: Foundation creams function as a canvas for the implementation of makeup products. They provide an adhesion medium for the face powder and other makeup products that are layered on top as well as increase coverage and wearability. Additionally, foundation creams provide the skin with a smooth surface while assisting in the skin's homeostasis by preventing excessive drying or oiliness of the skin. Foundation cream gives a smooth and balanced complexion along with helping to conceal imperfections. They are available in an array of shades. (Jeevitha & Mariyappan, 2023)
- **Cleansing creams**: The uses of the products are mainly personal hygiene and cosmetic purposes. These products keep the skin looking and feeling fresh and clean by eliminating dirt, excess oil and makeup residue from the face and neck. They are frequently proposed as a pre-makeup step, and are important in the daily skincare routine. (Tekade et al., 2024)
- **Winter creams**: They are typically formulated as water-in-oil (W/O) emulsions which are characterized by a predominance of the oil phase over the water phase. Due to their increased oil content, W/O emulsions create a very high level of moisture and are helpful for dry, rough, and chapped skin in cold weather conditions. (Rai et al., 2019.)
- **Cold Cream**: Cold creams are mostly used as emollients with mild humectant properties. When applied, they are said to provide a cooling sensation and soften the skin. Unlike heavier ointments, they shouldn't interfere with the skin's natural oily protective layer. (Maurya et al., 2023)
- **All-purpose creams and general creams**: Because of their adaptability, these creams have become more widely used in recent years. They spread easily across the skin since they are slightly greasy but not greasy. These types of formulations can be used as nourishing creams, night creams, sunburn protection, or to treat dry and rough areas of the skin. (Rai et al., 2019.)
- **Night Creams**: These formulations are mainly intended for skin nourishment and the treatment of dryness. They are applied before bedtime and left on the skin overnight to allow gradual absorption of active ingredients. In comparison, massage creams are emollient-rich preparations used externally to lubricate and soften the skin during massage. (Jeevitha & Mariyappan, 2023)

- **Hand and body creams**: The hands are frequently one of the first areas to clearly show signs of aging, as washing them must be done often, which strips them of natural moisture. Hand and body lotions used regularly maintains a more soft, pliable skin and restores lost moisture. Hand and body lotions restore suppleness, and help to prevent dryness for skin of the palms and fingers that need an adequate amount of oils to remain flexible and to prevent cracking or chapping. (Pradeepa et al., 2023.)
- **Skin Protective creams**: These smooth, rich formulations are meant to cover the skin with a thin, invisible film, which primarily protects the skin from irritant materials, such as contact or occupational dermatitis. They also support the skin's own defenses and work to maintain a normal to combination skin type in balance. (Tekade et al., 2024)

1.1.4.3 Moisturizing cream

A Moisturizing cream is a topical cosmetic formulation designed to lubricate and hydrate skin. It serves an additional purpose in providing dry skin a smooth and supple appearance. These creams work both to minimize evaporation and to increase the water content of the skin's outer layer, thereby improving skin hydration. (Ganesh et al., 2025) By increasing the water content of the skin, they reduce evaporation. Humidifiers are used to supply or restore moisture. (Kakade et al., 2024) A moisturizing cream's primary purpose is to rehydrate dry skin. It also helps to remove impurities from the pores and provides a cooling, soothing impact on the body. (Ganesh et al., 2025) Moisturizers are often used in dermatology and are crucial for the treatment of dry skin conditions. Although the majority of formulations contain both occlusives and humectants, which jointly improve the stratum corneum's (SC) capacity to bind water, the word moisturizer is frequently used in a wide sense, leading to an improvement in skin hydration. (Chandrabhan et al., 2025.) Maintaining regular skincare regimens as part of overall wellbeing has grown more important as people's health has become more mindful in recent years. (Sharma et al., 2023)

WHY ARE MOISTURIZERS NECESSARY?

It is important to have good skin because it might make you feel less confident. Regular use of moisturizers helps maintain moisture, reduces the visibility of fine wrinkles, and improves overall skin smoothness. These effects have a positive effect on social interactions, psychological well-being, and quality of life in addition to boosting physical beauty. Furthermore, properly applying moisturizers benefits both healthy skin and dry skin conditions caused by dermatology. (Khambayatkar et al., 2024)

The ideal characteristics of a Moisturizer:

- It must not cause irritation or cause allergies.
- The formulation needs to be safe for topical application and non-irritating.

- It should spread easily on the skin, leave a pleasant feel after application, and provide a smooth finish rather than a sticky residue.
- It ought to lessen skin dryness and make the dull aspect of skin better. (Kakade et al., 2024)

2. MECHANISM OF ACTION OF MOISTURIZERS

Transepidermal water loss is the term denoting the gradual evaporation of water from the deeper layers of the skin inside the human body. The human body can regulate its water balance by the skin naturally maintains a dry, shedding outer layer that serves as a barrier against infections, dust, and physical harm. It also keeps the surface from being too dry, stiff, or delicate. The lipid bilayer that separates corneocytes has a major role in their ability to retain moisture. (Chaudhari et al., 2023)

Occlusives: In order to decrease transepidermal water loss, petroleum ointments work by forming a barrier on the skin. The occlusive strength increases with product thickness, with ointments being more effective than creams, and creams more effective than lotions. Under normal conditions, the skin loses approximately 4–8 g of water per square meter each hour. A light application of petrolatum can cut this loss by about half to three-quarters for several hours. Natural skin lipids also help maintain hydration in a similar way.

Humectants- These agents attract and retain water. Under conditions of high humidity (above 70%), they can pull moisture from the environment into the skin. More commonly, however, they transfer water from the dermis up to the epidermis, which may sometimes leave the skin feeling drier. A study published in Skin Research and Technology (2001) reported that humectants alone were not strongly linked with significant moisturizing benefits. For this reason, they are usually combined with occlusive ingredients in formulations. Most moisturizers also include water, which provides short-term hydration, helps dissolve other active components, and then eventually evaporates. (Mouna et al., 2023)

2.1. *Benefits of Moisturizers:*

- Regular use of moisturizers minimizes the risk of developing skin-related issues.
- They may also help reduce the visibility of blemishes.
- Moisturizers support skin elasticity and contribute to a youthful appearance.
- Consistent application can delay the formation of fine lines and wrinkles.
- Possible Drawbacks of Moisturizers:
- Excessive use may lead to over-hydration of the skin.
- Some formulations may contain ingredients that act as allergens in sensitive individuals. (Mouna et al., 2023)

2.2. *Advantages of Herbal Moisturizers*

- The capacity of herbal moisturizers to alleviate dry skin with little chance of adverse effects is one of their main advantages.
- They lessen the possibility of getting more skin issues.
- These formulas help to lessen wrinkles and other aging symptoms.
- They are lighter and less oily than many ointments. (Chaudhari et al., 2023)

2.3. *Disadvantages*

- Not all areas have easy access to a wide variety of herbal raw ingredients.
- It might be challenging to cover up their inherent flavor and smell in compositions.
- Herbal creams frequently exhibit less stability than ointments. (Chaudhari et al., 2023)

3. HUMAN SKIN

Fig. 1. Human Skin Structure.

The human body encompasses the largest organ, the skin, which is also a sensitive organ. Its thickness varies across the body but is typically 1-2 mm thick in adults. In (Gaikwad and Badak,2024) Correspondingly, skin also has a number of appendages, such as hair, nails, and glands. The skin has three main structural layers of:

1. Epidermis
2. Dermis
3. Subcutaneous (hypodermal) layer (Sushmitha et al., 2024)

3.1. *Epidermis*

The epidermis represents the exterior layer of the skin, providing a barrier that protects the body from the environment. (Narayanan et al., 2023) The epidermis comprises stratified, keratinized squamous epithelium that has varying thicknesses throughout the body. (Yadav et al., 2023) The epidermis thickness is approximately

0.05 mm on the eyelids to nearly 1.5 mm on the palms and soles. Specialized cells include Merkel cells, Langerhans' cells which have an immunological function, melanocytes which produce pigment and are linked to melanoma, and sensory nerve terminals are found in this layer.

The epidermis itself is divided into five separate sublayers that cooperate to renew the skin's surface throughout time. (Narayanan et al., 2023)

3.1.1. *Layers of Epidermis: Layers of the Epidermis*

- The epidermis is composed of five distinct strata:
- Stratum corneum (horny layer)
- Stratum lucidum, present only in thick skin such as the palms, soles, and digits
- Stratum granulosum (granular layer)
- Stratum spinosum (prickle-cell layer)
- Stratum basale (germinative layer). (Lawton, 2019.)

3.2. *Dermis*

The dermis is a layer of skin that is primarily composed of connective tissue, is strong, yet flexible. It is supported by collagen and elastic fibers woven throughout. Excessive stretching can cause some of the elastic fibers to break, and when the fibers tear, a permanent scar develops, known as striae, or stretch scars. Striae are commonly associated with obesity or pregnancy. (Lawton, 2019.)

3.2.1. *Hypodermis*

The hypodermis, also referred to as the subcutaneous tissue, serves as the subcutaneous layer of skin and is made up of adipose cells, blood vessels, and immune cells, including macrophages, which function to insulate the body and absorb mechanical shock. The hypodermis also contains specialized secretory epithelial cells and hair follicles. (Mariyappan & Jeevitha, 2023)

4. INGREDIENTS

Table 1. Role of ingredients.

INGREDIENTS	ROLE
Lactic acid	Exfoliation and Hydration
Aloe vera	Moisturizer
Bees wax	Stabilizing agent
Cetosteryl alcohol	Emulsifier
Glycerine	Emmollient
Rose water	Fragrance
Borax	Alkaline agent

Neem oil	Antioxidant

4.1. *Lactic acid*

Often lactic acid is utilized as a natural ingredient in cosmetic formulations. While its main function initially addressed pH management, it offers additional benefits including skin-brightening activity, antimicrobial protection and skin hydration. Its hydration effect is related to the powerful water holding capacity of lactate, and the skin-lightening effect can be attributed to the inhibition of the formation of tyrosine—a precursor involved in the formation of melanin.

Fig. 2. Lactic acid.

Overall, lactic acid and its salts, as naturally occurring component of the human body, are aligned with the larger movement towards safer, natural cosmetic ingredients that offer benefits of skin brightness, exfoliation and regeneration. (Surjushe et al., 2008)

4.2. *Aloevera*

The etymology of aloe vera is composed of two classical terms: Aloe vera derived from the Arabic language Alloeh, the term aloe meaning ‘a bitter and shining substance’ in Arabic, and vera, the Latin word for ‘true’. Aloe vera, which has been valued for its medicinal properties, has been applied as a therapeutic agent epic 2000 years ago, touted by ancient Greek practitioners as a therapeutic agent with diverse properties, and, referenced by ancient Egyptian records as the ‘plant of immortality.’

Fig. 3. Aloevera.

The aloe vera remains an important ingredient in contemporary dermatological practice, utilized for its cooling, hydrating, and healing properties of various types of wounds. (Abd Alsaheb et al., 2023.)

- **Synonyms**: Aloe barbadensis Mill., Aloe barbadensis var. chinensis Haw
- **Biological Source**: Aloe is obtained from the dried latex (juice) of the leaves of Aloe barbadensis Miller.
- **Family**: Liliaceae
- **Major Chemical Constituents**: Barbaliin, Aloin, Isobarbaloin, Aloe-emodin, Aloesone, Aloinosides A & B, and resins. (Pareek et al., 2013)

4.3. *Bees Wax*

Cosmetic formulations in which the beeswax is commonly incorporated at concentrations of 1–3% to improve texture and consistency. It also enhances the overall stability of creams by preventing phase separation. Additionally, other bee-derived products, such as pollen, are often valued for their antimicrobial properties. (Pavlačková et al., 2024.)

Fig. 4. Bees Wax.

- **Botanical name**: cera alba
- **Synonym**: paraffin-wax
- **Biological source**: Bees wax is a naturally occurring wax produced in the bees hives by honey bees a mellifera
- **Family**: Apidae
- **Chemical constituents**: esters, hydrocarbon, free fatty acids and other_chemical Constitutes. (Valhekar et al., 2024)

4.4. *Glycerine*

Glycerine, as a humectant, elevates surface hydration by both attracting and binding water from the environment, as well as from deeper layers of the skin. It is generally used in conjunction with occlusive ingredients to help retain moisture and prevent evaporation.

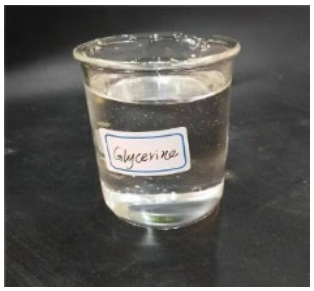

Fig. 5. Glycerine.

The American Academy of Dermatology highlights several benefits of glycerine, including its ability to hydrate the stratum corneum, reinforce the skin's protective barrier, shield against external irritants, and support tissue repair by enhancing wound healing. (Mahabish et al., 2024.)

4.5. *Rose water*

Rose water is a fragrant, water-based extract obtained by distilling the petals of roses, most often from Rosa damascena. It has antibacterial, anti-inflammatory, and moisturizing properties in addition to antioxidants. Rose water is frequently used in dermatological and cosmetic formulations due to its mild and soothing qualities, especially for sensitive and acne-prone skin. (Singh, 2025)

Fig. 6. Rose Water.

4.6. *Borax*

Borax is used in the cosmetics industry to stop bacteria from growing. It also aids in the removal of dead skin cells and the reduction of skin microbes. Borax is an emulsifying agent that helps integrate the water and oil components of the cold cream, making the product more stable and less likely to separate over time. (Manisha & Hingane, 2022)

Fig. 6. Borax.

4.7. *Neem oil*

Neem oil may be a beneficial ingredient in moisturizing lotions due to its various benefits.

Fig. 7. Neem Oil.

Adding neem oil to moisturizing cream formulations may have several benefits, such as:

- **Moisturizing**: Neem oil is a powerful moisturizer since it is rich in fatty acids and glycerides. In creams, it hydrates and nourishes the skin to encourage a smooth and supple texture.
- **Antioxidant**: Antioxidants found in neem oil may aid in providing protection to the skin against damage from free radicals. Neem oil could also improve the skin's overall health and protection when applied in moisturizing agents.. (Ghule et al., 2024)

5. METHODS OF PREPARATION OF MOISTURIZING CREAM

5.1. *Method 1: Trituration Method*

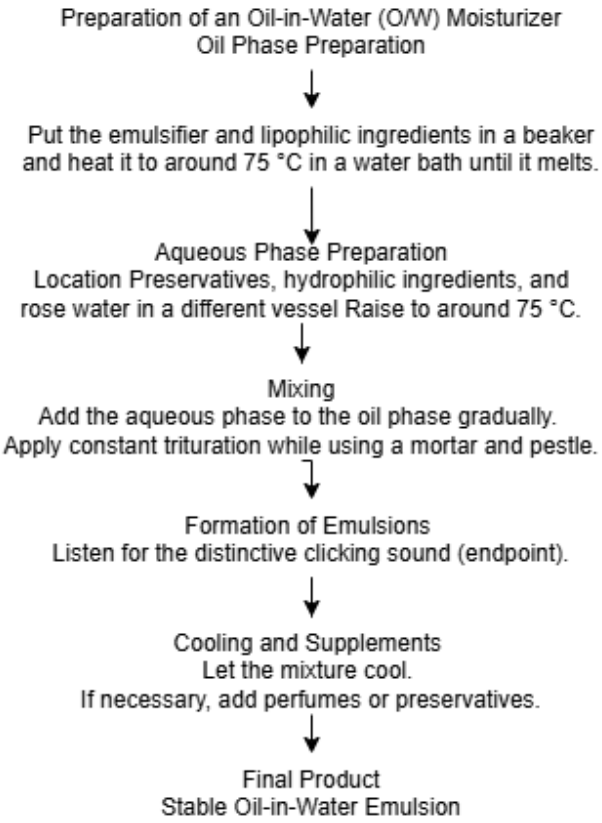

Fig. 8. Trituration Method 1.

5.2. *Method 2: Trituration Method*

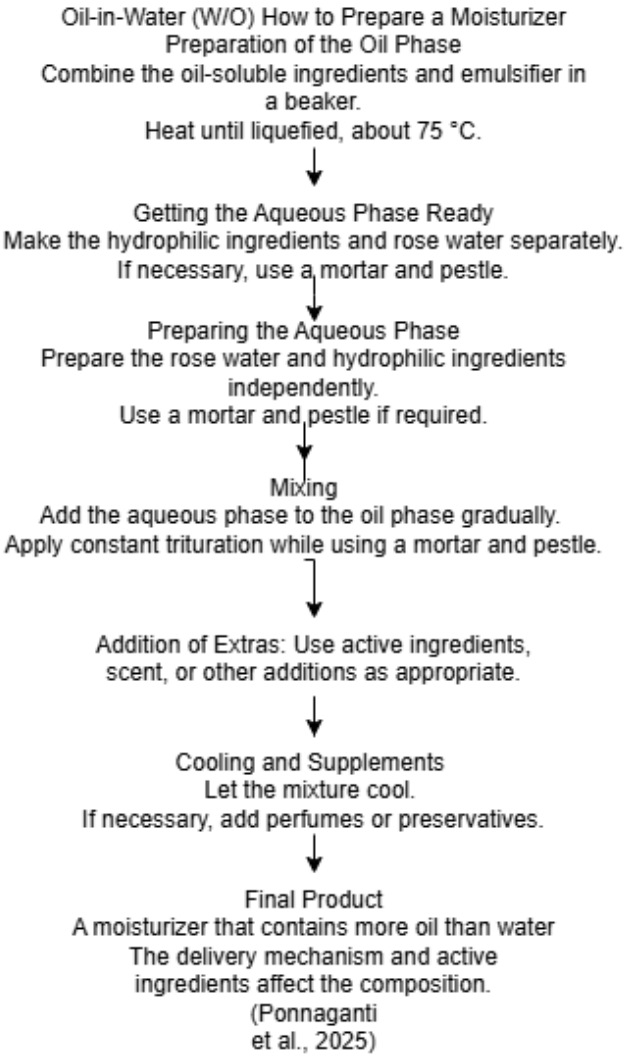

Fig. 9. Trituration Method 2.

5.3. *Method 3: Fusion Method*

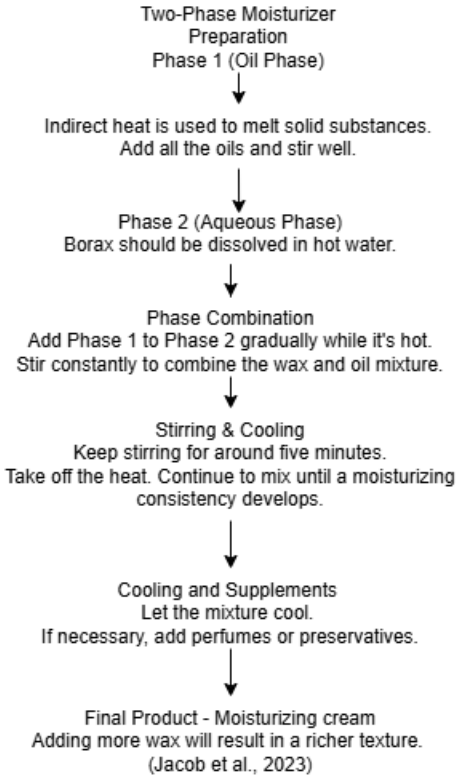

Fig. 10. Fusion Method.

5.4. *Evaluation parameters*

5.4.1. *Physical evaluation*

This is mostly used to evaluate the color, texture, consistency, and scent of the cream. (Shinde & Kawade, 2024)

- **Purpose**: To evaluate the cream's stability, texture, color, odor, and appearance. guarantees that customers will find the cream aesthetically pleasing. aids in identifying physical instability, including discolouration, grittiness, and phase separation. serves as a first quality control measure prior to additional testing.

5.4.2. *pH*

This refers generally to the acid values of a material. Cream usually has a pH of between 4 and 7. This test was measured with a digital pH meter or pH paper. (Chandrabhan et al., 2023.)

- **Purpose**: To assess the cream formulation's acidity and alkalinity. guarantees the cream's suitability for skin because the pH of normal skin is between 4.5 and 6.5. prevents allergic responses, dryness, and skin irritation brought on by an improper pH. Verifies the stability of the active substances because many of them are sensitive to pH. guarantees adherence to accepted quality standards.

5.4.3. *Phase Separation*

The cream compositions were kept between 25 and 100 °C in airtight containers that were shielded from the sun. Phase separation was then assessed 24 hours later and again 30 days later. No phase separation was seen in any of the three formulations, according to observations that were noted and confirmed. Singh and colleagues, 2024. The medication impact can be improved by using other formulation techniques, such as a herbal phytosomal drug delivery system. (Kamireddy et al., 2024)

- **Purpose**: To evaluate the cream's stability, texture, color, odor, and appearance. guarantees that customers will find the cream aesthetically pleasing. aids in identifying physical instability, including discolouration, grittiness, and phase separation. serves as a first quality control measure prior to additional testing.

5.4.4. *Irritancy Test*

This test determines if chemicals and materials irritate the skin or mucous membranes in order to assess their safety. First, the dorsal surface of the left hand has a noticeable patch. The time is recorded after the cream formulation has been applied to this area. After a few minutes of the formulation being applied to the skin, the region is examined for irritation. (Petare et al., 2024)

- **Purpose**: To assess the cream formulation's acidity and alkalinity. guarantees the cream's suitability for skin because the pH of normal skin is between 4.5 and 6.5. prevents allergic responses, dryness, and skin irritation brought on by an improper pH. Verifies the stability of the active substances because many of them are sensitive to pH.

5.4.5. *Homogeneity test*

Through tactile evaluation and visual examination, the formulations' homogeneity was assessed. (Valhekar et al., 2024)

- **Purpose**: To guarantee that there are no lumps, grit, or uneven component distribution in the cream's composition. ensures that active compounds are delivered in consistent doses. enhances both user acceptance and visual appeal.

5.4.6. *Stability test*

In order to conduct stability experiments for batch F3, the formulation was stored at room temperature and at 45°C. Over the course of a month, the product was routinely inspected for any visual alterations or indications of phase separation. (Petare et al., 2024)

- **Purpose**: To assess the cream's ability to retain its chemical, physical, and microbiological characteristics under various circumstances (such as temperature, light, and storage duration). guarantees that there are no changes in phase separation, color, texture, or odor. aids in forecasting the formulation's storage conditions and shelf life.

6. SUMMARY

The primary objective of this review is to investigate the potential formulation of a moisturizing cream composed of: aloe vera, beeswax, borax, neem oil, glycerin, lactic acid, and rose water. These substances are known to provide several benefits, including deep hydration, skin soothing, anti-inflammatory effects, and improved skin texture. The proposed formulation aims to enhance skin protection and well-being by sufficiently moisturizing skin that decreases or replaces the need for synthetic chemicals. Each ingredient is evaluated based on its individual utility and its ability to work together to augment the overall efficacy of a moisturizing cream.

7. CONCLUSION

Moisturizers are still one of the most important aspects of modern dermatological and cosmetic therapy, as they aid in strengthening the epidermal barrier, replenishing skin hydration, and improving overall skin condition. When a moisturizer is applied to the skin, it enters the stratum corneum layer, where humectants increase water content, emollients soften the skin, and occlusive ingredients reduce transepidermal water loss. These ingredients can work together to maintain an optimal skin environment and to help prevent symptomatic conditions associated with dry skin. Herbal ingredients are rapidly being incorporated into moisturizers as they are safe, inexpensive, and provide multiple benefits. Across the breadth of plants for cosmetics and self-care, glycerin is a well-known humectant; aloe vera provides soothing and hydrating properties; neem oil provides antibacterial and barrier properties; beeswax and cetostearyl alcohol are natural emulsifiers and stabilizers; and rose water provides refreshing and toning properties. Lactic acid is a natural alpha-hydroxy acid that brings a different dimension to the product by facilitating skin regeneration and the absorption of other active ingredients by providing gentle exfoliation to be combined with hydrating properties. Lactic acid is still safe and effective in cosmetic formulations at concentrations between 1% and 2%, with the stability at an appropriate pH for skin, according to compatibility studies that have been documented in the literature. Standards for evaluation for functional and cosmetic acceptability for moisturizing creams include spreadability, viscosity,

pH, stability study, and skin tolerance tests. Literature indicates the optimal format should resemble skin's physiologic pH, retain viscosity with time, distribute uniformly without leaving an oily feel, and demonstrate product stability in a variety of climates. In addition to moistening of the skin, moisturizing lotions with natural active ingredients provide additional value. When it comes to lactic-acid based products, it resulted in significant improvement in smoothness, texture, and environmental stress deriving from protection, as well as brightness and rejuvenation. Thus, these formulations have a number advantages of traditional moisturizer. Regarding a wider context the social benefits are considerable. Herbal moisturizers lessen reliance on petrochemical-based materials used in cosmetics and provide a safer and more sustainable alternative for synthetic cosmetic use, and respond to the worldwide increases in demand for natural and eco-friendly skincare. In addition, these formulations may have the advantage of providing dermatological treatment at a reasonable price, particularly in areas where dermatological specialist access is limited.

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