FORMULATION & EVALUATION OF HERBAL SUNSCREEN LOTION

[1]Kajal V. Kapse, [2]Prof. Dr Muzaffar Ahmed Farooqi, [3]Prof.Bushra Hundekari
[1]Student, [2]Research Guide, [3]Research Co-Guide
[123]Aurangabad pharmacy college

***Abstract*—This project focuses on the formulation and evaluation of a herbal sunscreen lotion using natural ingredients. Sunlight contains harmful UV rays such as UVA and UVB, which can damage the skin and lead to problems like sunburn, tanning, dark spots, early aging, and other skin issues. Many chemical sunscreens are available, but they may cause skin irritation, allergies, and long-term side effects. Because of this, there is a growing interest in herbal and natural products, which are safer and more skin-friendly.**

In this study, a herbal sunscreen lotion was prepared using ingredients such as Aloe vera gel, turmeric extract, carrot seed oil, coconut oil, beeswax, vitamin E, and rose water. These ingredients were selected because they have useful properties like natural sun protection, antioxidant action, moisturizing effect, and skin healing ability. The lotion was prepared by the emulsion method, where the oil phase (beeswax, coconut oil, carrot seed oil) and aqueous phase (aloe vera gel, turmeric extract, rose water) were heated separately to the same temperature and then mixed together with continuous stirring. This process helped to form a smooth, stable, and uniform lotion.

The prepared formulation was evaluated for different parameters such as appearance, color, odor, pH, viscosity, spreadability, washability, and stability. The results showed that the lotion had good consistency, smooth texture, and suitable pH for skin application. It was easy to apply, spread well on the skin, and showed no signs of irritation. The formulation also remained stable without any phase separation during storage.

The overall results indicate that the herbal sunscreen lotion provides effective protection from harmful sun rays while also keeping the skin moisturized and healthy.

In conclusion, the formulated herbal sunscreen lotion is safe, effective, economical, and easy to prepare, and it can be used as a natural alternative to synthetic sunscreens for daily skin care.

***Index Terms*—Herbal Sunscreen Lotion, Aloe vera, Turmeric Extract, Carrot Seed Oil, Natural SPF, Herbal Cosmetics, UV Protection, Photoprotective Activity, Antioxidant, Skin Care,Herbal Formulation, Moisturizing Lotion, Anti-inflammatory Activity, Sunscreen Lotion, Herbal Skin Care, Cosmetic Preparation, Emulsion Method, Herbal Ingredients, Skin Nourishment, Stability Study, Spreadability, pH Evaluation, Herbal Product, Eco-friendly Cosmetics**

I. Introduction

The skin is the largest organ of the human body and acts as a protective barrier against external environmental factors such as dust, microbes, chemicals, and sunlight. Among these factors, sunlight plays an important role in both beneficial and harmful effects on the skin. Sunlight contains ultraviolet (UV) radiation, which is divided into three types: UVA, UVB, and UVC. UVC rays are mostly absorbed by the ozone layer and do not reach the earth's surface. However, UVA (320–400 nm) and UVB (290–320 nm) rays can penetrate the skin and cause damage.

UVA rays penetrate deeper into the skin and are mainly responsible for premature aging, wrinkles, and skin pigmentation, while UVB rays affect the outer layer of the skin and cause sunburn and redness. Long-term exposure to these rays can also increase the risk of serious skin problems. Therefore, protection from UV

radiation is very important for maintaining healthy skin.

To protect the skin from harmful UV rays, sunscreen preparations are widely used. Sunscreens are topical products that form a protective layer on the skin and either absorb or reflect UV radiation, thereby reducing its harmful effects. The effectiveness of sunscreen is measured by a value called Sun Protection Factor (SPF). SPF indicates how well a sunscreen can protect the skin from UVB rays. For example, a higher SPF value means better protection against sunburn.

In the market, most sunscreens are made using synthetic or chemical ingredients such as oxybenzone, avobenzone, and octinoxate. Although these sunscreens are effective, they may cause side effects like skin irritation, allergies, and sensitivity, especially in people with sensitive skin. Some synthetic ingredients may also have environmental impacts. Because of these concerns, there is a growing demand for herbal and natural sunscreen formulations that are safer and more eco-friendly.

Herbal sunscreens use plant-based ingredients that have natural protective properties against UV radiation. These ingredients are rich in antioxidants, vitamins, and bioactive compounds that help to protect the skin from damage caused by free radicals generated by UV exposure. In addition to sun protection, herbal ingredients also provide moisturizing, soothing, anti-inflammatory, and healing effects on the skin.
Some commonly used herbal ingredients in sunscreen formulations include Aloe vera, turmeric, carrot seed oil, coconut oil, and vitamin E. Aloe vera is known for its cooling, soothing, and moisturizing properties, and it helps in repairing damaged skin. Turmeric contains an active compound called curcumin, which has strong antioxidant and anti-inflammatory properties and helps in protecting the skin from harmful effects of sunlight. Carrot seed oil is considered one of the important natural ingredients with UV-protective properties, and it is rich in vitamins and antioxidants. Coconut oil acts as a natural moisturizer and helps in preventing dryness caused by sun exposure. Vitamin E is a powerful antioxidant that protects the skin from oxidative damage and improves the stability of the formulation.

The preparation of sunscreen lotion involves the formation of an emulsion, which is a mixture of oil phase and aqueous (water) phase. In this formulation, ingredients like beeswax and oils form the oil phase, while aloe vera gel and rose water form the aqueous phase. Both phases are heated separately and then mixed together with continuous stirring to form a smooth and stable lotion. This type of formulation ensures proper mixing of ingredients and easy application on the skin.

After preparation, the sunscreen lotion must be evaluated to ensure its quality, safety, and effectiveness. Various evaluation parameters are used, such as appearance, color, odor, pH, viscosity, spreadability, and stability. The pH of the lotion should be suitable for the skin to avoid irritation. Spreadability ensures that the lotion can be easily applied, and stability studies help to determine whether the formulation remains uniform over time without separation.

In recent years, there has been a growing awareness among people regarding the use of natural and herbal products for skin care. Herbal formulations are considered safe, economical, and easily available, making them a good alternative to synthetic products. The use of herbal sunscreen not only protects the skin from harmful UV rays but also improves overall skin health by providing nourishment and hydration.

Therefore, the present study is focused on the formulation and evaluation of a herbal sunscreen lotion using natural ingredients. The aim is to develop a product that is effective, safe, and suitable for daily use, while

minimizing the side effects associated with chemical sunscreens. This study also helps in understanding the role of herbal ingredients in providing sun protection and improving skin condition.

II. Aim and Objectives

Aim :

The main aim of this project is to formulate and evaluate a herbal sunscreen lotion using natural ingredients that can protect the skin from the harmful effects of sunlight, especially ultraviolet (UV) rays. The study is focused on de0veloping a formulation that is safe, effective, stable, and suitable for daily use. Unlike synthetic sunscreens, which may cause irritation, allergies, or other side effects, this project aims to prepare a product using herbal ingredients that are gentle on the skin and provide additional benefits such as moisturizing, soothing, and healing action.

Another important aim is to develop a sunscreen lotion that has good physical properties, such as smooth texture, proper consistency, easy spreadability, and acceptable pH for skin application. The project also aims to ensure that the formulation remains stable over time without phase separation or change in quality.

Furthermore, this study aims to create a cost-effective and easily prepared formulation using readily available natural materials. Overall, the aim is to develop a natural, user-friendly, and effective herbal sunscreen lotion that can be used as a safer alternative to conventional chemical-based sunscreens for regular skin protection.

Objectives :

1.To formulate a herbal sunscreen lotion

The primary objective is to prepare a sunscreen lotion using herbal ingredients such as Aloe vera, turmeric, carrot seed oil, and coconut oil by using a suitable method like emulsion technique.

2.To select suitable natural ingredients

To choose ingredients that have UV-protective, antioxidant, moisturizing, and healing properties which help in protecting and nourishing the skin.

3.To prepare a stable and uniform formulation

To develop a lotion that has good consistency, smooth texture, and uniform mixing of oil and water phases without separation.

4.To evaluate physicochemical properties

To check important parameters like appearance, color, odor, pH, viscosity, spreadability, and washability to ensure the quality of the formulation.

5.To perform stability studies

To observe the formulation under different storage conditions and check whether it remains stable over time without changes in its physical properties.

6.To ensure safety of the formulation

To conduct a skin irritation test to confirm that the lotion is safe and does not cause redness or irritation on the skin.

7.To study the effectiveness of the formulation

To observe how well the sunscreen protects the skin from sunlight and maintains skin hydration and smoothness.

8.To develop an economical product

To prepare a formulation that is cost-effective and easy to prepare using easily available herbal ingredients.

III. Literature Review

- Sharma et al. (2017)

Sharma and co-workers developed a herbal sunscreen cream containing Aloe vera and turmeric extract. The study reported that Aloe vera showed excellent moisturizing and soothing activity, while turmeric exhibited antioxidant and anti-inflammatory properties. The prepared formulation had good consistency, smooth texture, and acceptable spreadability. The authors concluded that herbal ingredients improve skin protection naturally.

- Patel and Shah (2018)

Patel and Shah prepared a polyherbal sunscreen lotion using carrot seed oil, coconut oil, and Aloe vera gel. Their research showed that carrot seed oil contributed natural SPF activity due to the presence of beta-carotene and antioxidants. Coconut oil improved hydration and prevented skin dryness. The prepared lotion showed good stability and no irritation on skin application.

- Kaur et al. (2018)

Kaur and colleagues studied the antioxidant activity of turmeric and Vitamin E in herbal cosmetic preparations. The authors reported that antioxidants reduce oxidative stress caused by UV radiation and help prevent premature aging of the skin. The formulation also showed good moisturizing properties.

- Mehta et al. (2019)

Mehta and co-workers formulated a herbal lotion using Aloe vera gel and rose water. The study concluded that herbal lotions provide cooling and soothing effects on the skin. The prepared formulation had good homogeneity, acceptable pH, and easy spreadability. The authors suggested that herbal preparations are safer alternatives to synthetic products.

- Verma et al. (2019)

Verma and colleagues investigated the photoprotective activity of carrot seed oil in topical formulations. Their research showed that carrot seed oil contains natural antioxidants and vitamins that help in UV protection. The prepared sunscreen formulation demonstrated effective sun-protective activity and good skin compatibility.

- Singh and Mishra (2020)

Singh and Mishra developed a herbal cream containing coconut oil and beeswax. Coconut oil acted as a moisturizer and emollient, while beeswax improved the viscosity and stability of the formulation. The prepared cream showed smooth texture and easy application on the skin.

- Rao et al. (2020)

Rao and co-workers evaluated herbal formulations containing turmeric and Aloe vera for skin protection. They concluded that herbal antioxidants protect skin cells from damage caused by UV rays and environmental pollutants. The formulations also reduced skin irritation and dryness.

- Joshi et al. (2021)

Joshi and colleagues formulated a polyherbal sunscreen lotion containing Aloe vera, turmeric, carrot seed oil, and Vitamin E. The formulation was evaluated for pH, spreadability, washability, and stability. Results showed that the lotion was stable, non-greasy, and suitable for daily use.

- Gupta and Sharma (2021)

Gupta and Sharma prepared a herbal cosmetic cream using natural oils and herbal extracts. Their study demonstrated that herbal creams are more compatible with skin and produce fewer side effects compared to synthetic formulations. The prepared cream exhibited good consistency and moisturizing effect.

- Deshmukh et al. (2021)

Deshmukh and co-workers studied the role of natural antioxidants in sunscreen preparations. They reported that antioxidants like Vitamin E and turmeric help in reducing free radical formation caused by UV radiation and improve skin health.

- Kale et al. (2022)

Kale and colleagues developed a herbal sunscreen gel containing Aloe vera and carrot seed oil. The formulation showed good spreadability, pleasant appearance, and cooling effect. The authors concluded that herbal formulations provide effective protection with minimal irritation.

- Patil et al. (2022)

Patil and co-workers evaluated the stability of herbal sunscreen formulations prepared using natural ingredients. The study showed that formulations containing beeswax and coconut oil remained stable during storage and maintained good consistency and texture.

- Chavan et al. (2023)

Chavan and colleagues prepared a herbal sunscreen lotion using Aloe vera, turmeric, and Vitamin E. The formulation exhibited good antioxidant activity and satisfactory skin compatibility. The authors concluded that herbal sunscreens are effective alternatives to chemical sunscreens.

IV. Herbal Drugs Profile

Herbal sunscreen lotion is a topical preparation made by using natural plant-based ingredients that help protect the skin from harmful ultraviolet (UV) rays of sunlight. Unlike synthetic sunscreen preparations, herbal sunscreen lotions are safer, eco-friendly, and produce fewer side effects on the skin. Herbal ingredients provide antioxidant, anti-inflammatory, moisturizing, soothing, and skin protective actions. In the present formulation, Aloe vera gel, Turmeric, Carrot seed oil, Coconut oil, and Rose water are used as important herbal ingredients because of their beneficial effects on the skin.

1. Aloe Vera Gel

Aloe vera

Aloe vera is one of the most commonly used medicinal plants in cosmetic and pharmaceutical preparations. Aloe vera gel is obtained from the fresh leaves of Aloe vera plant belonging to family Liliaceae. The transparent gel present inside the leaves contains many biologically active compounds beneficial for skin care.

Chemical Constituents Aloe vera contains:

- Aloin
- Aloe-emodin
- Vitamins A, C, and E
- Polysaccharides
- Amino acids
- Enzymes

Role in Herbal Sunscreen Lotion

Aloe vera acts mainly as a moisturizing and soothing agent in sunscreen lotion. Exposure to sunlight often causes dryness, redness, irritation, and inflammation of the skin. Aloe vera provides cooling action and maintains proper hydration of the skin. It also helps repair damaged skin tissues.

Benefits

- Moisturizes and softens the skin
- Provides cooling effect
- Reduces skin irritation and sunburn
- Helps heal damaged skin
- Suitable for sensitive skin

Because of its anti-inflammatory and antioxidant properties, Aloe vera improves the overall effectiveness of herbal sunscreen formulations.

2. Turmeric

Turmeric

Turmeric is obtained from dried rhizomes of Curcuma longa belonging to family Zingiberaceae. It is widely used in traditional medicine systems such as Ayurveda due to its medicinal and cosmetic benefits.

Chemical Constituents

- Turmeric mainly contains:
- Curcumin
- Turmerone
- Essential oils
- Proteins and carbohydrates

Role in Herbal Sunscreen Lotion

Curcumin present in turmeric possesses strong antioxidant and anti-inflammatory activities. UV radiation from sunlight produces free radicals in the skin, leading to skin damage, pigmentation, premature aging, and inflammation. Turmeric neutralizes free radicals and protects the skin from oxidative stress.

Benefits

- Protects skin from UV damage
- Reduces tanning and pigmentation
- Prevents skin inflammation
- Improves skin complexion
- Delays premature aging

Turmeric also gives natural glow to the skin and improves skin health. Therefore, it is an important herbal ingredient in sunscreen lotion formulations.

3. Carrot Seed Oil

Carrot Seed Oil

Carrot seed oil is obtained from seeds of Daucus carota belonging to family Apiaceae. It is rich in vitamins and antioxidants and is commonly used in skincare products.

Chemical Constituents Carrot seed oil contains:

- Beta-carotene
- Vitamin A
- Carotol
- Antioxidants
- Essential fatty acids

Role in Herbal Sunscreen Lotion

Carrot seed oil acts as a natural UV protective agent. Beta-carotene and antioxidants present in the oil help reduce damage caused by ultraviolet radiation. It nourishes the skin and supports regeneration of skin cells.

Benefits

- Protects skin against harmful UV rays
- Prevents wrinkles and fine lines
- Improves skin nourishment
- Promotes skin regeneration
- Maintains healthy skin texture

Carrot seed oil is also helpful in reducing oxidative stress and preventing premature aging caused

by continuous sun exposure.

4. Coconut Oil

Coconut Oil

Coconut oil is obtained from dried kernels of Cocos nucifera belonging to family Arecaceae. It is widely used in cosmetic preparations because of its excellent moisturizing and nourishing properties.

Chemical Constituents Coconut oil contains:

- Lauric acid
- Capric acid
- Fatty acids
- Vitamin E
- Polyphenols
- Role in Herbal Sunscreen Lotion

Coconut oil acts as an emollient and moisturizer in herbal sunscreen lotion. It forms a protective layer over the skin and prevents loss of moisture caused by sunlight exposure. Coconut oil also improves the texture and spreadability of the lotion.

Benefits

- Prevents skin dryness
- Softens and smoothens skin
- Nourishes damaged skin
- Provides skin conditioning effect
- Enhances formulation consistency

The antioxidant properties of coconut oil also help protect the skin from environmental damage.

5. Rose Water

Rose Water

Rose water is prepared from petals of Rosa species belonging to family Rosaceae. It is commonly used in herbal cosmetic formulations because of its cooling and refreshing properties.

Chemical Constituents Rose water contains:

- Flavonoids
- Phenolic compounds
- Essential oils
- Vitamins

Role in Herbal Sunscreen Lotion

Rose water acts as a natural skin toner and cooling agent. Sunlight exposure often causes irritation, redness, and discomfort on the skin. Rose water refreshes and soothes the skin while maintaining skin pH balance.

Benefits

- Provides cooling and refreshing effect
- Reduces skin redness and irritation
- Maintains skin pH
- Gives pleasant fragrance
- Improves skin freshness

Rose water also improves the sensory properties of sunscreen lotion and increases user acceptability.

6. Bees Wax

Beeswax

Biological Source

Bees wax is a natural wax obtained from the honeycomb of honey bees, mainly Apis mellifera, belonging to family Apidae. It is secreted by worker bees and used for construction of honeycomb cells.

Synonyms

- Bees wax
- Cera alba (White bees wax)
- Cera flava (Yellow bees wax)
- Chemical Constituents
- Bees wax contains:
- Esters of fatty acids
- Long-chain alcohols
- Hydrocarbons
- Free fatty acids
- Vitamin A traces

Description

- Color: Yellow to pale yellow
- Odor: Pleasant honey-like odor
- Nature: Solid, smooth, and waxy substance

Role in Herbal Sunscreen Lotion

- Bees wax acts as:
- Thickening agent
- Emulsifying agent
- Stabilizing agent
- Emollient

It helps improve the consistency and texture of the lotion and prevents separation of oil and water phases.

Uses in Sunscreen Lotion

- Provides smooth texture to formulation
- Forms protective layer on skin
- Prevents moisture loss
- Improves stability of lotion
- Enhances spreadability and consistency

Advantages

- Natural and skin-friendly
- Non-toxic and safe for topical use
- Improves moisturizing property
- Gives glossy and smooth appearance

Importance in Herbal Formulation

Bees wax is widely used in herbal creams, lotions, ointments, lip balms, and cosmetic preparations because of its excellent stabilizing and moisturizing properties. It increases the shelf life and overall quality of herbal sunscreen lotion.

V. Need of the Work

1) To protect the skin from harmful UVA and UVB rays.
2) To reduce skin problems such as sunburn, tanning, pigmentation, and premature aging.
3) To prepare a safer alternative to synthetic sunscreens.
4) To minimize side effects like skin irritation, allergy, redness, and dryness caused by chemical sunscreens.
5) To utilize natural herbal ingredients with photoprotective properties.
6) To provide additional skin benefits such as moisturization and nourishment.
7) To develop an eco-friendly and biodegradable sunscreen formulation.
8) To increase the use of herbal cosmetics in skincare products.
9) To formulate a stable, effective, and skin-friendly sunscreen lotion.
10) To prepare an economical herbal sunscreen suitable for regular use.

VI. Materials and Methodology

1. Materials :

The materials used for the formulation of herbal sunscreen lotion were selected based on their natural origin, safety, and skin-protective properties. Each ingredient plays an important role in providing sun protection, moisturizing effect, stability, and overall quality of the formulation.

1.Aloe vera gel is used as the main base of the formulation. It has soothing, cooling, and

moisturizing properties. It helps in reducing skin irritation caused by sunlight and keeps the skin hydrated.

2. Turmeric extract is added because of its antioxidant and anti-inflammatory properties. It helps in protecting the skin from damage caused by UV rays and also improves skin tone.

3.Carrot seed oil is one of the most important ingredients in the formulation. It is rich in vitamins and antioxidants and provides natural sun protection, making it a key SPF-contributing component.

4.Coconut oil is used as an emollient, which helps to soften and smooth the skin. It also prevents dryness and improves the overall texture of the lotion.

5.Beeswax acts as a thickening agent and stabilizer. It helps in giving proper consistency to the lotion and prevents separation of oil and water phases.

6.Vitamin E is added as an antioxidant. It protects the skin from free radical damage and also improves the stability and shelf life of the formulation.

6.Rose water is used as a vehicle to adjust the volume of the formulation. It also provides a refreshing and mild fragrance to the lotion.

2.**Formulation of Herbal Sunscreen Lotion (60 g)**

The composition for 60 g of herbal sunscreen lotion is given below:

Sr. No.	Ingredient	Quantity (g/mL)	Role in Formulation
1	Aloe vera gel	12 g	Base, soothing and moisturizing agent
2	Turmeric extract	3 g	Antioxidant, anti-inflammatory, UV protection
3	Carrot seed oil	6 mL	Natural SPF agent
4	Coconut oil	9 mL	Emollient, improves texture
5	Beeswax	5 g	Thickening agent, stabilizer
6	Vitamin E	0.6 mL	Antioxidant, improves stability
7	Rose water	q.s to 60 g	Vehicle, adds volume

2. Methodology

The herbal sunscreen lotion was prepared by using the emulsion method, which involves the mixing of oil phase and aqueous phase to obtain a smooth, stable, and homogeneous lotion. The formulation was prepared carefully under controlled conditions to maintain the stability and effectiveness of the herbal ingredients.

Step 1: Collection and Preparation of Materials

All the required materials such as Aloe vera gel, turmeric extract, carrot seed oil, coconut oil, beeswax, Vitamin E, and rose water were collected and measured accurately according to the formulation table.

Before preparation, all glassware and apparatus were cleaned and dried properly to avoid contamination. Accurate weighing and measuring of ingredients were done to maintain uniformity and quality of the formulation.

Step 2: Preparation of Oil Phase

The oil phase was prepared by taking beeswax and coconut oil in a clean beaker. The beaker was placed on a water bath and heated at about 70°C. Heating was continued until the beeswax melted completely and mixed uniformly with the coconut oil.

After complete melting, carrot seed oil was added into the mixture and stirred properly. Carrot seed oil acts as the main natural SPF-contributing ingredient in the formulation.

The oil phase was maintained at the same temperature to ensure proper mixing during emulsification.

Step 3: Preparation of Aqueous Phase

In another clean beaker, the aqueous phase was prepared by mixing Aloe vera gel, turmeric extract, and rose water.

Aloe vera gel was used for its soothing and moisturizing properties.

Turmeric extract was added for antioxidant and anti-inflammatory action.

Rose water acted as a vehicle and refreshing agent.

The mixture was heated gently on a water bath to about 70°C. Maintaining the same temperature for both phases is important because it helps in proper formation of emulsion and prevents separation of phases.

Step 4: Emulsification Process

The prepared oil phase was slowly added into the aqueous phase with continuous stirring. Stirring was done using a glass rod or mechanical stirrer to ensure proper mixing of both phases.

Continuous stirring is an important step because it helps in the formation of a uniform, smooth, and stable emulsion. Proper emulsification prevents separation of oil and water phases and improves the consistency of the lotion.

The stirring process was continued until a homogeneous lotion with smooth texture was obtained.

Step 5: Cooling of Formulation

After complete emulsification, the prepared lotion was allowed to cool gradually to about 40°C while continuous gentle stirring was maintained. Cooling helps in improving the thickness and stability of the lotion.

Proper cooling is necessary because some ingredients are heat-sensitive and may lose their activity if added at high temperature.

Step 6: Addition of Vitamin E

Once the temperature of the formulation reached around 40°C, Vitamin E was added to the lotion.

Vitamin E was added during the cooling stage because it is sensitive to heat.

Vitamin E acts as an antioxidant and helps in protecting both the skin and formulation from oxidative damage. The lotion was stirred properly to ensure uniform distribution of Vitamin E throughout the formulation.

Step 7: Adjustment of Final Weight

After complete mixing, the quantity of the formulation was adjusted by adding rose water quantity sufficient (q.s.) to make the final weight 20 g.

The lotion was mixed thoroughly to maintain uniform consistency and appearance.

Step 8: Packaging and Storage

The prepared herbal sunscreen lotion was transferred into a clean, dry, airtight container using a spatula. The container was labeled properly with:

- Name of formulation
- Date of preparation
- Batch number

The formulation was stored at room temperature away from direct sunlight and moisture for further evaluation studies.

VII. Evaluation Parameters

Evaluation of herbal sunscreen lotion is an important step in formulation development. It helps in determining the quality, safety, stability, effectiveness, and acceptability of the prepared formulation. A good herbal sunscreen lotion should possess proper consistency, smooth texture, suitable pH, good spreadability, stability during storage, and effective sun protection activity. Different physical, chemical, and stability evaluation tests are carried out to ensure that the sunscreen lotion is suitable for topical application and provides adequate protection against harmful ultraviolet (UV) rays.

The following evaluation parameters are commonly performed for herbal sunscreen lotion.

1. Physical Appearance

Physical appearance is the preliminary evaluation parameter carried out immediately after preparation of the lotion. The formulation is visually observed for color, odor, texture, smoothness, consistency, and phase separation.

Procedure

A small quantity of prepared lotion is taken in a clean container and visually examined under normal light conditions.

Observations

- Color should be uniform and attractive
- Odor should be pleasant
- Texture should be smooth and free from grittiness
- Lotion should not show phase separation
- Consistency should be uniform

Importance

Physical appearance determines the overall quality and acceptability of the formulation. Presence of lumps, grittiness, or phase separation indicates instability of the lotion.

2. pH Determination

The pH of sunscreen lotion is evaluated because skin compatibility depends largely on pH. Human skin normally has a pH between 5 and 7. A lotion with very acidic or alkaline pH may cause irritation and dryness.

Procedure

- About 1 g of lotion is dispersed in 100 ml distilled water.
- The dispersion is stirred properly.
- pH is measured using a calibrated digital pH meter.

Observations

- The pH should remain within the acceptable skin pH range.

Importance

- Prevents skin irritation and redness
- Maintains skin compatibility
- Ensures stability of formulation
- Improves safety of topical application
- A properly balanced pH increases user comfort and product effectiveness.

3. Spreadability Test

Spreadability determines the ease with which the lotion spreads on the surface of the skin. Good spreadability ensures uniform application and formation of a protective layer over the skin.

Procedure

- A small amount of lotion is placed between two glass slides.
- A specific weight is placed over the upper slide for uniform spreading.
- The time required for the upper slide to move over the lower slide is measured.

Observations

- The lotion should spread easily without excessive rubbing.

Importance

- Ensures easy application on skin
- Improves patient compliance
- Provides uniform sunscreen protection
- Reduces product wastage
- A lotion with good spreadability is more convenient and comfortable to use.

4. Viscosity Determination

Viscosity refers to the thickness and flow behavior of the lotion. It is one of the important parameters affecting stability and application properties.

Procedure

- Viscosity is measured using a Brookfield viscometer at controlled temperature.

Observations

The lotion should possess optimum viscosity. It should neither be too thick nor too thin.

Importance

- Determines consistency of lotion
- Affects spreadability and pourability
- Prevents phase separation
- Improves stability during storage
- Proper viscosity enhances the elegance and quality of the formulation.

5. Homogeneity Test

- Homogeneity test is carried out to check uniform distribution of ingredients in the lotion.

Procedure

- The lotion is visually inspected after application on glass slide or skin surface.

Observations

- Smooth appearance
- Uniform consistency
- Absence of lumps and coarse particles

Importance

- Ensures even distribution of herbal ingredients
- Improves formulation quality
- Prevents uneven application on skin
- A homogeneous lotion gives better therapeutic and cosmetic effects.

6. Washability Test

Washability determines how easily the lotion can be removed from the skin using water.

Procedure

- Lotion is applied on the skin.
- The applied area is washed with normal tap water.
- Ease of removal is observed.

Observations

- The lotion should be washable without leaving excessive oily residue.

Importance

- Improves user convenience
- Prevents sticky sensation
- Increases patient acceptability
- Good washability makes the formulation more suitable for daily use.

7. Irritancy Test

The irritancy test is performed to evaluate the safety of the sunscreen lotion on the skin.

Procedure

- A small quantity of lotion is applied to a small portion of skin.
- The area is observed for 24 hours.
- Any signs of irritation are noted.

Observations

- No redness
- No itching
- No swelling
- No inflammation

Importance

- Confirms safety of formulation
- Detects allergic reactions
- Ensures suitability for topical application
- This test is especially important for herbal cosmetic preparations.

8. Stability Study

Stability study determines whether the lotion remains stable under different storage conditions over time.

Procedure

The prepared lotion is stored at:

- Room temperature
- Refrigerated temperature
- Elevated temperature
- The formulation is periodically evaluated for:
- Color change

- Odor change
- pH variation
- Consistency
- Phase separation

Observations

- No significant changes should occur during storage.

Importance

- Determines shelf life of product
- Ensures long-term stability
- Detects instability problems
- Maintains effectiveness of formulation
- Stable products retain their quality and performance throughout storage.

9. SPF Determination

SPF (Sun Protection Factor) is the most important evaluation parameter for sunscreen formulations. It measures the ability of sunscreen lotion to protect skin from UVB radiation.

Procedure

SPF can be determined using spectrophotometric analysis by measuring UV absorbance of the formulation.

Observations

- Higher SPF values indicate better sun protection.
- Importance
- Determines sunscreen effectiveness
- Measures UV protection ability
- Protects skin from sunburn and UV damage
- SPF value indicates the overall protective efficiency of the sunscreen lotion.

10. Moisturizing Property

Moisturizing property is evaluated to determine the hydration effect of the lotion on skin.

Procedure

- The lotion is applied on the skin and observed for smoothness and hydration effect.

Observations

- Skin should remain soft, hydrated, and non-dry after application.

Importance

- Prevents dryness caused by sun exposure

- Maintains skin softness
- Improves skin nourishment
- Ingredients like Aloe vera gel and Coconut oil enhance moisturizing action.

11. Greasiness Test

Greasiness test determines the oily nature of the sunscreen lotion after application.

Procedure

- The lotion is applied on skin and observed for oily residue.

Observations

- The formulation should not leave excessive greasy film.

Importance

- Improves cosmetic elegance
- Enhances user acceptability
- Prevents sticky sensation on skin
- Non-greasy formulations are generally preferred by users.

Evaluation parameters are essential for ensuring the quality, safety, effectiveness, and stability of herbal sunscreen lotion. Parameters such as physical appearance, pH, spreadability, viscosity, homogeneity, washability, irritancy, stability study, SPF determination, moisturizing property, and greasiness test help in assessing the performance of the formulation. Proper evaluation ensures that the sunscreen lotion provides adequate protection from harmful UV radiation while maintaining skin hydration, smoothness, and overall skin health.

Evaluation Parameters

Sr. No.	Evaluation Parameter	Procedure	Observation	Importance
1	Physical Appearance	The prepared lotion is visually examined for color, odor, texture, consistency, and phase separation under normal light.	Lotion should be smooth, uniform, pleasant in odor, and free from lumps or phase separation.	Helps determine overall quality, elegance, and acceptability of formulation.
2	pH Determination	About 1 g of lotion is dispersed in distilled water and pH is measured using a digital pH meter.	pH should be within skin-compatible range (5–7).	Prevents skin irritation and maintains formulation stability.
3	Spreadability Test	Lotion is placed between two glass slides and the time	Lotion should spread easily and uniformly	Ensures easy application and

		required for spreading is measured.	on the skin surface.	uniform protective film formation.
4	Viscosity Determination	Viscosity is measured using Brookfield viscometer at controlled temperature.	Lotion should possess optimum viscosity, neither too thick nor too thin.	Determines consistency, stability, and ease of application.
5	Homogeneity Test	Lotion is visually inspected after applying on skin or glass slide.	Formulation should appear smooth and homogeneous without coarse particles.	Ensures uniform distribution of ingredients throughout the lotion.
6	Washability Test	Lotion applied on skin is washed with tap water and ease of removal is observed.	Lotion should be easily washable without leaving heavy residue.	Improves user convenience and patient acceptability
7	Irritancy Test	Small quantity of lotion is applied on skin and observed for 24 hours.	No redness, itching, swelling, or irritation should occur.	Confirms safety and suitability of formulation for topical use.
8	Stability Study	Lotion is stored at different temperatures and observed periodically for changes.	No significant change in color, odor, pH, or consistency should occur.	Determines shelf life and long-term stability of product.
9	SPF Determination	SPF value is determined using spectrophotometric method.	Higher SPF value indicates better UV protection.	Measures effectiveness of sunscreen against harmful UV rays.
10	Moisturizing Property	Lotion is applied on skin and hydration effect is observed.	Skin should remain soft, smooth, and hydrated after application.	Prevents dryness and improves skin nourishment.
11	Greasiness Test	Lotion is applied on skin and checked for oily residue.	Formulation should be non-greasy and non-sticky.	Improves cosmetic elegance and user comfort.
12	Consistency Test	Lotion is examined manually by touch and appearance.	Consistency should be smooth, creamy, and uniform.	Ensures proper formulation texture and easy application.

13	Extrudability Test	Lotion is pressed from collapsible container or tube.	Lotion should come out easily with slight pressure.	Determines ease of product removal from packaging.
14	After Feel Test	Sensation on skin after application is evaluated manually	Skin should feel soft, smooth, and non-sticky.	Enhances cosmetic acceptability of the product.
15	Phase Separation Test	Lotion is stored and observed for separation of oil and water phases.	No phase separation should occur during storage.	Indicates physical stability of emulsion system.

Chemical Constituents Test

Chemical constituent tests are performed to identify the presence of important phytochemicals present in herbal ingredients used in the sunscreen lotion. These tests help to confirm the presence of active constituents responsible for antioxidant, anti-inflammatory, and skin-protective activities.

1. **Test for Alkaloids**

. Procedure

- Take a small quantity of herbal sunscreen lotion extract in a test tube.
- Add few drops of Mayer's reagent.

. Observation

- Formation of cream or white precipitate indicates the presence of alkaloids.

.Inference

- Alkaloids are present.

2. **Test for Flavonoids**

. Procedure

- Take the extract in a test tube.
- Add few drops of dilute sodium hydroxide solution.
- Then add dilute hydrochloric acid.

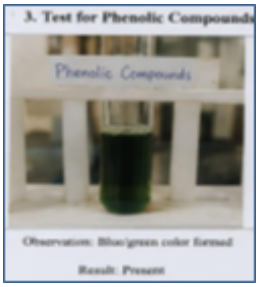
. Observation

- Yellow color appears and disappears after adding acid.

.Inference

- Flavonoids are present.

3. Test for Phenolic Compounds



.Procedure

- Take a small amount of extract.
- Add few drops of ferric chloride solution.

. Observation

- Formation of blue, green, or dark color indicates presence of phenolic compounds.
- .Inference
- Phenolic compounds are present.

4. Test for Tannins

. Procedure

- Add few drops of ferric chloride solution to the extract.

. Observation

- Formation of blue-black or greenish-black color indicates tannins.

. Inference

- Tannins are present.

5. Test for Saponins

. Procedure

- Shake the extract with distilled water in a test tube.

. Observation

- Formation of stable foam indicates presence of saponins.

. Inference

- Saponins are present.

6. Test for Terpenoids

. Procedure

- Mix extract with chloroform.
- Carefully add concentrated sulfuric acid along the side of the test tube.

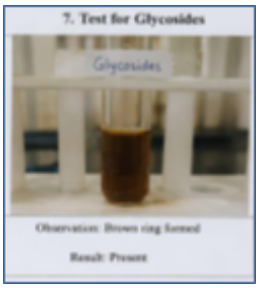
. Observation

- Formation of reddish-brown color at the interface indicates terpenoids.

.Inference

- Terpenoids are present.

7. Test for Glycosides



.Procedure

- Add glacial acetic acid and ferric chloride to the extract.
- Slowly add concentrated sulfuric acid.

. Observation

- Formation of brown ring indicates glycosides.

. Inference

- Glycosides are present.

Chemical Constituents Test

Sr. No.	Chemical Constituent	Test/Reagent Used	Procedure	Observation	Result
1	Alkaloids	Mayer's reagent	Add few drops of Mayer's reagent to the extract	Cream or white precipitate formed	Present
2	Flavonoids	Sodium hydroxide + HCl	Add NaOH solution followed by dilute HCl	Yellow color appears and disappears after adding acid	Present
3	Phenolic compounds	Ferric chloride solution	Add few drops of ferric chloride solution to extract	Blue or green color formed	Present
4	Tannins	Ferric chloride solution	Add ferric chloride solution to extract	Blue-black or greenish-black color formed	Present
5	Saponins	Distilled water	Shake extract with distilled water	Stable foam formed	Present
6	Terpenoids	Chloroform + Conc. H_2SO_4	Add chloroform and sulfuric acid to extract	Reddish-brown color formed at interface	Present
7	Glycosides	Glacial acetic acid + Ferric chloride + H_2SO_4	Add reagents carefully to extract	Brown ring formed	Present

VIII. Future Scope

The formulated herbal sunscreen lotion showed satisfactory results and has good future potential in the field of herbal cosmetics and skincare products. Due to increasing awareness about the harmful effects of synthetic chemicals, people are now preferring natural and herbal products for skin protection and care.

In future, more herbal ingredients with higher antioxidant and photoprotective properties can be added to improve the SPF value and effectiveness of the formulation. Advanced evaluation methods may also be used for accurate SPF determination and long-term stability studies.

The formulation can further be developed into different dosage forms such as creams, gels, sprays, and sunscreen sticks according to consumer preference. Additional ingredients with anti-aging, anti-pigmentation, and moisturizing properties may also be incorporated to provide multiple skincare benefits.

Clinical and dermatological studies can be carried out on a larger population to confirm the safety and effectiveness of the herbal sunscreen lotion for different skin types. Commercial production and improved packaging may increase market acceptability and consumer demand.

Overall, herbal sunscreen formulations have a wide future scope because they are safe, eco-friendly, economical, and suitable for regular use in protecting the skin from harmful UV radiation.

IX. Result & Discussion

Sr. No	Evaluation Parameter	Observation/Result	Discussion
1	Appearance	Smooth and uniform lotion	Indicates proper emulsification and good formulation quality
2	Color	Light yellow	Due to turmeric and carrot seed oil
3	Odor	Pleasant characteristic odor	Rose water improved fragrance and acceptability
4	Texture	Soft and smooth	Suitable for easy topical application
5	Homogeneity	Uniform and free from lumps	Indicates proper mixing of ingredients
6	Grittiness	No grittiness observed	Shows smooth consistency of lotion
7	pH	5.8 – 6.5	Suitable for skin and non-irritating
8	Spreadability	Good	Lotion spread easily over skin surface
9	Viscosity	Appropriate consistency	Neither too thick nor too thin
10	Washability	Easily washable	Did not leave excessive oily residue
11	Irritancy Test	No irritation observed	Safe for skin application
12	Moisturizing Property	Good moisturizing effect	Aloe vera and coconut oil maintained hydration
13	Greasiness	Non-greasy	Improved cosmetic acceptability

14	Stability Study	Stable during storage	No significant changes observed
15	Phase Separation	Absent	Indicates good stability of emulsion
16	SPF Activity	Satisfactory	Herbal ingredients provided photoprotection
17	Skin Compatibility	Good	Suitable for regular use
18	Overall Acceptability	Satisfactory	Formulation possessed good pharmaceutical and cosmetic properties

X. Conclusion

The present study was successfully carried out to formulate and evaluate a herbal sunscreen lotion using natural herbal ingredients such as Aloe vera gel, Turmeric, Carrot seed oil, Coconut oil, and Rose water. The main objective of the study was to prepare a safe, effective, stable, and skin-friendly sunscreen formulation capable of protecting the skin from harmful ultraviolet (UV) radiation while also improving skin hydration and nourishment. Excessive exposure to sunlight causes various harmful effects such as sunburn, tanning, premature aging, pigmentation, skin dryness, and long-term skin damage. Therefore, the development of an herbal sunscreen lotion using natural ingredients was considered beneficial because herbal formulations generally produce fewer side effects and provide additional skin care benefits compared to synthetic products.

The prepared herbal sunscreen lotion showed satisfactory physical characteristics including smooth texture, uniform consistency, attractive appearance, pleasant odor, and good homogeneity. The formulation did not show any signs of grittiness, lump formation, or phase separation, indicating proper emulsification and mixing of ingredients. The smooth and elegant texture of the lotion improved its cosmetic acceptability and ease of application on the skin surface.

Various evaluation parameters such as physical appearance, pH determination, spreadability, viscosity, homogeneity, washability, irritancy, moisturizing property, greasiness, stability study, and SPF determination were performed to assess the quality and effectiveness of the formulation. The pH of the lotion was found to be within the acceptable skin-compatible range, indicating that the formulation is safe for topical application and unlikely to produce skin irritation or allergic reactions. Spreadability studies showed that the lotion spread uniformly on the skin without excessive rubbing, which is important for proper sunscreen coverage and patient convenience.

The viscosity of the formulation was found to be appropriate, neither too thick nor too thin, thereby ensuring easy application and good stability. Homogeneity studies confirmed uniform distribution of all herbal ingredients throughout the formulation. Washability studies revealed that the lotion could be easily removed from the skin using water without leaving excessive oily residue. The greasiness test indicated that the lotion was non-sticky and cosmetically elegant, which increases user acceptability during regular use.

The irritancy test demonstrated that the prepared herbal sunscreen lotion was safe and non-irritant to the skin. No redness, itching, swelling, or inflammation was observed after application. This

result confirmed the compatibility of herbal ingredients with the skin and highlighted the safety of the formulation for topical use. Stability studies performed under different storage conditions showed no significant changes in color, odor, texture, consistency, or pH of the formulation. No phase separation or instability was observed during the study period, indicating that the lotion possessed good physical and chemical stability.

The herbal ingredients used in the formulation played an important role in improving the effectiveness and therapeutic value of the sunscreen lotion. Aloe vera gel acted as a natural moisturizer and soothing agent that helped maintain skin hydration and reduce irritation caused by sunlight exposure. Turmeric provided strong antioxidant and anti-inflammatory activity due to the presence of curcumin, which helped protect the skin from oxidative damage and premature aging. Carrot seed oil contributed natural photoprotective activity and nourished the skin because of the presence of beta-carotene and Vitamin A. Coconut oil functioned as an emollient and skin conditioning agent that prevented dryness and improved skin softness. Rose water provided cooling, refreshing, and soothing effects while also improving the fragrance and overall acceptability of the lotion.

The SPF evaluation confirmed that the prepared herbal sunscreen lotion possessed satisfactory sun protective activity against harmful UV rays. The herbal antioxidants present in the formulation helped reduce free radical formation and protected the skin from sunburn, tanning, pigmentation, and environmental damage. The formulation therefore not only acted as a sunscreen but also provided moisturizing, soothing, anti-aging, and skin nourishing benefits.

Overall, the study concluded that the formulated herbal sunscreen lotion is safe, effective, stable, and suitable for topical application. The formulation successfully combined the benefits of natural herbal ingredients to provide UV protection along with additional skin care advantages. Compared to synthetic sunscreens, herbal sunscreen lotions offer better skin compatibility, fewer adverse effects, natural origin, and eco-friendly properties. Hence, the prepared herbal sunscreen lotion can be considered a promising herbal cosmetic preparation for daily skin protection and maintenance of healthy skin.

References

[1] Cosmetics Formulation Manufacturing and Quality Control

Sharma PP. Cosmetics: Formulation, Manufacturing and Quality Control. 5th Edition. Vandana Publications Pvt. Ltd., Delhi; 2014.

This book provides detailed information regarding formulation techniques, preparation methods, quality control tests, evaluation parameters, and stability studies of cosmetic and herbal preparations including creams and lotions.

[2] Indian Pharmacopoeia

Indian Pharmacopoeia Commission. Indian Pharmacopoeia. Ghaziabad: Ministry of Health and Family Welfare, Government of India; 2022.

Indian Pharmacopoeia contains official standards for pharmaceutical substances and excipients used in formulation development. It provides information regarding purity, quality standards, and evaluation methods.

[3] Trease and Evans Pharmacognosy

Evans WC. Trease and Evans Pharmacognosy. 16th Edition. Saunders Elsevier Publication; 2009.

This reference book explains medicinal plants, herbal drugs, chemical constituents, pharmacological activities, and therapeutic uses of natural ingredients such as Aloe vera, Turmeric, Coconut oil, and Rose.

[4] Pharmacognosy

Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 56th Edition. Nirali Prakashan; 2021.

The book includes detailed study of herbal drugs, biological sources, chemical constituents, medicinal uses, and applications of plant-based ingredients used in cosmetic and pharmaceutical preparations.

[5] Harry's Cosmeticology

Wilkinson JB and Moore RJ. Harry’s Cosmeticology. 7th Edition. Chemical Publishing Company, New York; 1982.

This book is an important reference for cosmetic formulation development, emulsion preparation, sunscreen evaluation, skin care products, and cosmetic quality control testing.

[6] Handbook of Cosmetic Science and Technology

Barel AO, Paye M, Maibach HI. Handbook of Cosmetic Science and Technology. 4th Edition. CRC Press; 2014.

The handbook provides scientific information related to cosmetic technology, sunscreen preparations, herbal cosmetics, skin compatibility studies, and safety evaluation methods.

[7] Introduction to Cosmetic Formulation and Technology

Gabriella Baki and Kenneth S Alexander. Introduction to Cosmetic Formulation and Technology. Wiley Publications; 2015.

This book explains formulation principles, preparation methods, ingredients used in cosmetic products, emulsification techniques, and stability testing procedures.

[8] The Wealth of India

Council of Scientific and Industrial Research (CSIR). The Wealth of India: Raw Materials. New Delhi; 2005.

This reference provides information regarding Indian medicinal plants, herbal ingredients, botanical descriptions, therapeutic properties, and industrial applications.

[9] Indian Medicinal Plants

Warrier PK, Nambiar VPK, Ramankutty C. Indian Medicinal Plants: A Compendium of 500 Species. Orient Longman Pvt. Ltd.; 1996.

The book contains detailed information regarding traditional medicinal plants, pharmacological activities, and medicinal uses of herbal ingredients used in Ayurvedic and cosmetic preparations.

[10] Herbal Cosmetics Handbook

Ashawat MS and Saraf S. 10.Herbal Cosmetics Handbook. Pragati Prakashan; 2008.

This handbook includes information on herbal cosmetic formulations, natural ingredients, preparation procedures, evaluation parameters, and applications of herbal skin care products.

[11] Textbook of Cosmetic Dermatology

Robert Baran and Howard I Maibach. Textbook of Cosmetic Dermatology. Taylor and Francis Publication; 2005.

The book discusses skin physiology, UV radiation effects, sunscreen mechanisms, skin protection methods, and cosmetic dermatology concepts.