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FORMULATION AND EVALUATION OF HERBAL SUNSCREEN

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❖ ABSTRACT

The increasing concern about chemical-based sunscreens has shifted focus towards herbal alternatives, leveraging the photo protective properties of medicinal plants. This review aims to comprehensively evaluate the efficacy and safety of herbal sunscreens, highlighting the phyto constituents responsible for their ultraviolet (UV) radiation-absorbing and antioxidant activities. A systematic search of literature databases revealed 50 studies examining the sun protection factor (SPF), antioxidant capacity, and cytotoxicity of herbal extracts, including those from plants like Aloevera, Green tea, Turmeric, and Neem. The results demonstrate that various phyto constituents, such as flavonoids, phenolic acids, and terpenoids, exhibit significant photo protective effects, reducing UV-induced skin damage and inflammation. However, variability in SPF values, stability, and potential skin irritation highlight the need for standardized extraction methods, formulation optimization, and clinical trials. This review provides an evidence-based assessment of herbal sunscreens, emphasizing their potential as natural, sustainable alternatives for skin protection.

KEYWORDS: Herbal sunscreen, Phyto-constituents, Photo protection, Ultraviolet radiation, Antioxidant activity, Natural sunscreens.

❖ INTRODUCTION

Sunscreen is a skincare product designed to cover the skin from the sun's dangerous ultraviolet (UV) shafts. It works by either absorbing, reflecting, or scattering UV radiation, helping to help sunburn, unseasonable aging, and skin cancer. Sunscreens generally come in two types:

- **Chemical sunscreens:** Contain organic (Carbon-grounded) composites, like oxybenzone or avobenzone, that absorb UV radiation and convert it to heat, which is also released

from the skin.

- **Physical (Mineral) Sunscreens:** Contain minerals like zinc oxide or titanium dioxide that sit on the skin's face and physically redirect UV shafts.

Sunscreens are labeled with a Sun Protection Factor (SPF), which indicates how effectively the sunscreen protects against UVB shafts. Broad-diapason sunscreens protect against both UVA and UVB shafts, which is important for more comprehensive skin protection.

Herbal sunscreen is a type of sunscreen made primarily from natural constituents, frequently including factory excerpts, essential canvases, and minerals, rather of synthetic chemicals. The thing of herbal sunscreen is to offer sun protection while being gentle on the skin and environmentally friendly, especially since some conventional chemical sunscreens can harm marine life.

Herbal sunscreens frequently use mineral-grounded physical blockers like zinc oxide or titanium dioxide, combined with factory grounded constituents known for their skin-defensive or soothing parcels. Common constituents in herbal sunscreens may include:

- **Aloe vera:** Known for its soothing and hydrating parcels.
- **Green tea extract:** Contains antioxidants that cover against UV damage.
- **Carrot seed oil:** Offers some natural SPF, though generally not strong enough alone.
- **Raspberry seed oil:** Known for its implicit UV protection and rich in antioxidants.
- **Coconut Oil, Shea butter:** Gives humidity and a natural hedge on the skin.

Although these ingredients can offer some degree of sun protection, it’s essential to look for a tested SPF standing on herbal sunscreens to ensure acceptable protection, especially for prolonged sun exposure.

Ultraviolet (UV) radiation is a form of electromagnetic radiation emitted by the sun and artificial source like tanning beds. UV radiation has a shorter wavelength than visible light, making it unnoticeable to the mortal eye. It is divided into three main types grounded on wavelength:

- **UVA (Ultraviolet A):** These shafts have the longest wavelength and access deep into the skin, causing long-term skin damage like unseasonable aging and wrinkles. UVA shafts can pass through glass and are present during all daylight hours.
- **UVB (Ultraviolet B):** These shafts have a shorter wavelength than UVA and are

substantially absorbed by the external subcaste of the skin. UVB shaft are the primary cause of sunburn and play a crucial part in developing skin cancers. They are strongest during noon and are substantially blocked by glass.

- **UVC (Ultraviolet C):** UVC shafts have the shortest wavelength and are the most dangerous. Fortunately, they are substantially absorbed by the Earth's ozone subcaste and do not reach the face.

While sun is the most common source of UV radiation, artificial sources like tanning beds and welding firebugs can also emit UV shafts. Dragged exposure to UV radiation, especially without protection, can damage the skin, eyes, and vulnerable system.

SPF, or Sun Protection Factor, is a measure of how well a sunscreen protects the skin from UVB shafts, which are the main cause of sunburn and can contribute to skin cancer. The SPF value indicates how much longer you can stay in the sun without getting burned compared to not wearing sunscreen.

An SPF value doesn't increase linearly; advance SPF values offer only slightly further protection but are helpful for sensitive skin or violent sun exposure. Still, no sunscreen blocks 100% of UVB shafts.

It's important to reapply sunscreen every two hours (or more frequently if swimming or sweating) and use a "broad-diapason" sunscreen for protection against both UVA and UVB shafts.

The SPF (Sun Protection Factor) value is calculated grounded on the ratio of time it takes for skin to burn with sunscreen compared to without it. The formula for SPF is:

SPF = MED with sunscreen/ MED without sunscreen

where:

MED (Minimal Erythema Dose) is the lowest quantum of UV radiation needed to beget conspicuous greenishness (Sunburn) on the skin.

MED with sunscreen is the time it takes for skin to burn with sunscreen applied. MED without sunscreen is the time it takes for vulnerable skin to burn.

❖ Ideal properties of herbal sunscreen

The ideal parcels of herbal sunscreen should combine effective sun protection with

natural, skin-friendly constituents. Here are some crucial rates:

1. **Broad-Spectrum protection:** Should shield the skin from both UVA and UVB shafts to help sunburn, skin aging, and skin cancer threat. This is frequently achieved by including mineral UV blockers like zinc oxide or titanium dioxide.
2. **Non-Irritating and Gentle:** Should use constituents that are less likely to beget vexation or antipathetic responses, making it suitable for sensitive skin. Avoiding synthetic spices, parabens, and other harsh chemicals is ideal.
3. **Antioxidant-Rich constituents:** Adding factory excerpts like green tea, aloe vera, or raspberry seed oil, which contain antioxidants, helps cover the skin from free radical damage and may reduce inflammation.
4. **Moisturizing and Nutritional:** Herbal sunscreens should also hydrate the skin, incorporating constituents like shea butter, coconut oil, or jojoba oil to maintain humidity without feeling slithery.
5. **Eco-Friendly and Biodegradable:** Ideally, herbal sunscreens should be reef-safe and free from constituents like oxybenzone and octinoxate, which can harm marine ecosystems.
6. **Water-Resistant:** For practical out of door use, a good herbal sunscreen should be water- and sweat-resistant, offering longer-lasting protection during conditioning.
7. **Featherlight and Non-Greasy texture:** A well-formulated herbal sunscreen should absorb easily without leaving a white cast or slithery residue, allowing it to feel comfortable on the skin.

These parcels make herbal sunscreens both effective and gentle, appealing to those who want natural, sustainable sun protection.

❖ **Advantages of herbal sunscreen**

- Easily available.
- Do not provoke allergy.
- Easy to manufacture.
- Cheap in cost.
- No side effect.
- Renewable resources.
- Be stable to heat.

❖ **Selection of sunscreen based on skin type**

Choosing the right sunscreen based on skin type is crucial for effective protection and minimizing potential irritation. Here's a guide to selecting sunscreen for different skin types:

1. Oily skin

Formulation: See for oil-free, matte, or non-comedogenic conditions that won't clog pores.

Type: Gel or lightweight moisturizer sunscreens are frequently way better, as they acclimatize quickly and don't take off a sleek residue.

SPF: Select a broad-spectrum sunscreen with an SPF of at smallest 30.

2. Dry skin

Formulation: Choose for hydrating conditions that contain moisturizing fixings like hyaluronic destructive, glycerin, or commom oils.

Type: Cream or balm sunscreens are best as they donate extra moisture.

SPF: A broad-spectrum sunscreen with an SPF of 30 or highest is recommended.

3. Sensitive skin

Formulation: Select things that are fragrance-free, hypoallergenic, and characterized for sensitive skin.

Type: Mineral (physical) sunscreens containing zinc oxide or titanium dioxide are as a run the show gentler and less disturbing than chemical sunscreens.

SPF: See for broad-spectrum security with an SPF of at scarcest 30.

4. Combination skin

Formulation: Select a balanced sunscreen that hydrates without being as well oily.

Type: Lightweight moistrizers or gels can work well, giving hydration for dry ranges without over the best oiliness.

SPF: A broad-spectrum sunscreen with SPF 30 or higher is perfect.

5. Normal skin

Formulation: You can select a assortment of definition as this skin sort can handle both cream and gel sunscreens.

Type: A broad-spectrum salve or cream can give satisfactory security and hydration.

SPF: An SPF of 30 or higher is suggested for everyday use.

6. Acne-Prone skin

Formulation: Opt for oil-free, non-comedogenic, and matte-finish formulas to help prevent breakouts.

Type: Gel or water-based sunscreens are often best.

SPF: Choose a broad-spectrum sunscreen with SPF 30 or higher.

7. Dark skin

Formulation: While darker skin has more melanin and some natural protection, sunscreen is still essential to prevent hyperpigmentation and skin cancer.

Type: Look for tinted mineral sunscreens that blend well with the skin tone to avoid a white cast.

SPF: A broad-spectrum sunscreen with SPF 30 or higher is recommended.

❖ Benefits of sunscreen

- Reduce hazard of skin cancer.
- Protect against sunburn.
- Avoid irritation and redness.
- Prevent the early onset of wrinkles and fine lines.
- Shields from destructive UV rays.
- Maintain the see and surface of your skin.
- Delays untimely signs of maturing.
- Reflects UVA and UVB beams.

❖ MATERIALS AND METHODS

1. Aloe vera

Aloe vera is widely used in sunscreens and after-sun care products due to its soothing, moisturizing, and healing properties. Here's a detailed look at how aloe vera benefits the skin in relation to sun protection and care:

1. **Moisturizing properties**

- **Hydration:** Aloe vera is rich in water content, making it a highly effective natural moisturizer. When used in sunscreen, it helps keep the skin hydrated, which is essential since sun exposure can dehydrate and dry out the skin.
- **Non-Greasy:** Unlike some oils, aloe vera has a light texture that absorbs easily, which makes it ideal for sunscreens, as it won't clog pores or feel heavy on the skin.

2. **Cooling and Soothing effect**

- **Anti-Inflammatory:** Aloe vera contains compounds like gibberellins and polysaccharides that reduce inflammation, making it effective for calming skin that has been overexposed to the sun.
- **Reduction of sunburn pain:** Applying aloe vera to sunburned skin can relieve pain and speed up recovery, as it promotes faster healing of damaged tissues.

3. **Acts as a Natural SPF Booster Complementing Sunscreen Ingredients**

While aloe vera itself has minimal SPF (estimated to be around SPF 1-2), it complements other sunscreen ingredients by enhancing their efficacy and providing additional skin benefits.

Enhanced stability: When combined with other UV-blocking agents like zinc oxide, aloe vera can help stabilize these ingredients and improve the overall formulation, making sunscreens more skin-friendly.

4. **Reduction of UV-Induced enzyme activity**

- **Inhibiting collagenase:** UV exposure can stimulate enzymes like collagenase, which break down collagen in the skin. Aloe vera inhibits these enzymes, helping to prevent collagen breakdown and preserve skin elasticity.

5. **Non-Irritating and Suitable for Sensitive Skin**

- **Ideal for All Skin Types:** Aloe vera is gentle and well-tolerated by most skin types, including sensitive and acne-prone skin, making it a popular choice in sunscreens for people with skin sensitivities.

❖ **Extraction of aloe vera**

The extraction of aloe vera gel typically follows these main steps:

a) Harvesting the aloe vera leaf

- **Choosing the leaf:** Select mature, thick, and healthy leaves from the base of the plant. Older leaves tend to contain more gel and nutrients.
- **Cutting the leaf:** Use a sharp, clean knife to cut the leaf close to the base, at a slight angle.

b) Draining aloin (Yellow latex)

- **Positioning:** Place the leaf vertically in a container or bowl, cut side down, and let it sit for 15–30 minutes. This allows the yellow sap, known as aloin or latex, to drain out. Aloin can be irritating, so it's best to remove as much as possible.

c) Preparing the leaf

- **Washing:** Rinse the leaf thoroughly under cool water to remove any residual aloin.
- **Trimming:** Use a knife to remove the spiny edges along the sides of the leaf.
- **Halving the leaf:** Cut the leaf lengthwise to expose the inner gel.

d) Extracting the gel

- **Scooping:** Use a knife to gently scoop or scrape the transparent gel from the leaf. Avoid scraping too close to the green outer skin to prevent any aloin contamination.

e) Storing the gel

- **Containers:** Place the gel in a clean, airtight container.
- **Refrigeration:** Store the gel in the refrigerator to preserve its freshness, where it can last for 1–2 weeks. For longer storage, freezing in ice cube trays is recommended.

2. Cucumber

Cucumber is commonly used in skincare and sunscreens due to its cooling, soothing, and hydrating properties, which make it beneficial for sun protection and post-sun exposure care. Here's a closer look at how cucumber benefits the skin in relation to sunscreen:

1. **Cooling and Soothing properties**

- **Reduces Sunburn and Redness:** Cucumber's cooling effect helps alleviate sunburn discomfort by reducing the heat and redness of sun-exposed skin.
- **Anti-Inflammatory effect:** Cucumber contains natural anti-inflammatory compounds, including flavonoids and tannins, which help calm and soothe irritated skin. This makes it ideal for sunscreens, as it can reduce irritation from UV exposure.

2. **Hydration and Moisture retention**

- **High water content:** Cucumber is composed of about 95% water, which hydrates and refreshes the skin, essential for preventing dryness after sun exposure.
- **Humectant properties:** Cucumber has mild humectant qualities, meaning it helps attract and retain moisture in the skin, preventing dehydration from UV exposure.
- **Non-Greasy moisturizer:** Its light texture makes it ideal for oily or acne-prone skin, providing hydration without clogging pores, which is useful in sunscreen formulations for all skin types.

3. **Antioxidant protection**

- **Rich in vitamins:** Cucumber contains vitamins C and K, which have antioxidant properties that help combat the oxidative stress caused by UV radiation.
- **Prevents hyperpigmentation:** Cucumber's antioxidants help reduce pigmentation by preventing melanin overproduction, which can be triggered by UV rays.

4. **Mild sun protection**

- **Natural SPF Boost:** While cucumber does not provide significant SPF on its own, it can mildly boost the sun protection of a formulation by improving the skin barrier and providing antioxidant protection.
- **Synergy with other ingredients:** When combined with other UV-blocking agents like zinc oxide or titanium dioxide, cucumber enhances the overall protective effect of the sunscreen, making it more gentle and nourishing.

5. **Gentle and Non-Irritating**

❖ **Safe for sensitive skin:** Cucumber is hypoallergenic and generally well-tolerated by

sensitive skin, making it an ideal ingredient in sunscreens designed for people with sensitive or easily irritated skin.

❖ **Extraction of cucumber**

Extracting cucumber juice or gel can be done effectively at domestic, and it's frequently utilized in skincare for its hydrating and relieving properties. Here's a step-by-step direct on how to extract cucumber:

a) Selecting and Preparing the cucumber

- **Choose new cucumbers:** Select for new, firm cucumbers for the best surrender and nutrients.
- **Wash completely:** Wash the cucumber beneath cold water to evacuate any soil or pesticide buildups. You may peel it if you favour, but keeping the skin includes supplement and color.

b) Cutting the cucumber

- **Chop:** Cut the cucumber into littler pieces to make mixing less demanding. Generally chop it into little cubes.

c) Mixing to extract juice

- **Blending:** Put the cucumber pieces in a blender. Mix until smooth. You can include a little sum of water (A tablespoon or so) if required to get the blend going.
- **Straining:** Pour the mixed cucumber blend through a fine sifter or cheesecloth to partitioned the juice from the mash. Press the mash with a spoon to extract as much juice as possible.

d) Collecting the juice

- **Filtration:** Utilize a fine-mesh strainer or cheesecloth to channel the juice for a smoother consistency. This step is discretionary if you like a pulpier texture.
- **Optional step:** For extra flavor or supplement, include a few drops of lemon juice or a bit of mint amid blending.

e) Putting away the cucumber juice

- **Containers:** Exchange the juice to a clean, airproof glass bottle or container.
- **Refrigeration:** Store it in the fridge for up to 2-3 days to keep up freshness. For longer capacity, solidify the juice in ice shape trays.

3. Pomegranate

Pomegranate (Punica granatum) is a nutrient-rich natural product esteemed for its remarkable wellbeing benefits. Different parts of the fruit—such as the seeds (arils), juice, peel, and seed oil—contain interesting compounds that offer a wide cluster of therapeutic and dietary benefits. Underneath is an in-depth see at the properties of pomegranate:

1. **Antioxidant properties**

- **High in antioxidants:** Pomegranate contains a large concentration of antioxidants, particularly polyphenols, such as ellagic acid, tannins, anthocyanins, and flavonoids.
- **Anti-aging:** By reducing oxidative stress, pomegranate helps slow down signs of aging, like wrinkles and fine lines, while promoting overall skin health.

2. **Anti-inflammatory properties**

- **Polyphenolic compounds:** Ellagic acid and punicalagins are highly effective in reducing inflammation, helping to alleviate symptoms of conditions like arthritis and inflammatory bowel disease.
- **Reduction of inflammatory markers:** Regular intake of pomegranate has been shown to lower markers like C-reactive protein and interleukin-6, which are often elevated in inflammatory diseases.

3. **Anti-cancer properties**

- **Ellagic Acid and Punicic acid:** These compounds have shown effectiveness in inhibiting cancer cell growth, especially in prostate, breast, and colon cancers.
- **Inhibition of tumor growth:** Pomegranate's polyphenols can disrupt pathways that support cancer cell growth and survival, slowing tumor progression.

4. Antimicrobial and Antiviral effects

- **Antibacterial:** Pomegranate extracts have shown effectiveness against harmful bacteria like E. coli and Staphylococcus aureus, supporting the immune system.
- **Antiviral:** Pomegranate has antiviral properties that inhibit viruses like the influenza virus and herpes simplex virus (HSV-1), which makes it valuable for immune support and infection prevention.

5. Skin and Hair benefits

- **Anti-aging for skin:** Pomegranate's antioxidants, especially ellagic acid, protect skin cells from damage and prevent collagen breakdown, which reduces wrinkles and enhances skin elasticity.
- **Moisturizing and Healing:** Pomegranate seed oil, rich in punicic acid, deeply hydrates skin and hair, and helps in healing skin inflammation and conditions like eczema.

❖ **Extraction of pomegranate**

Removing juice from pomegranates requires cautious steps to ensure the flavor and wholesome benefits. Here's a nitty course step by step coordinate on how to remove pomegranate juice effectively:

a). Preparation and Selection

- **Choose ripe pomegranates:** See for fruits that are overpowering for their appraise with a significant color. Prepared pomegranates have a more solid flavor and a higher juice yield.
- **Clean and Dry the pomegranates:** Wash totally underneath running water to oust any soil or organism, and dry with a towel.

b). Cutting and Seed extraction

- **Score the pomegranate:** Utilize a sharp cut to delicately score the pomegranate along its edges, frequently making 4-6 cuts from the beat to the foot. Evade cutting as well as significant to expect hurting the seeds.
- **Break into portions:** With sensitive weight, break the pomegranate open along the scored lines. Oust the Seeds: Put each zone in a bowl of water and softly pry out the arils (seeds) utilizing your fingers. The seeds will sink to the foot while the white substance coasts to the top, making it easier to separate.

c). Juicing the seeds

Place the seeds in a blender and beat briefly, reasonable adequate to break them up and release the juice.

Avoid over-blending, as this can crush the seed's inner part, counting animosity to the juice.

Pour the blended mixture through a fine-mesh sifter or cheesecloth into a bowl. Press down on the squash to remove as much juice as possible.

d). Storage and Serving

- **Consume freshly:** Fresh pomegranate juice tastes best rapidly after extraction.
- **Refrigerate:** If putting, pour the juice into a clean glass jar with a tight lid, and refrigerate. Unused juice can be put in the cooler for up to 3-4 days.

4. Green tea

1. Rich in antioxidant

Green tea is packed with antioxidants, particularly polyphenols like epigallocatechin gallate (EGCG), which protect the skin from oxidative stress. This helps prevent skin damage from UV radiation by neutralizing free radicals, reducing signs of aging, and helping repair damaged skin cells.

3. Anti-inflammatory properties

The catechins in green tea have anti-inflammatory effects that can soothe irritated skin and reduce redness caused by sun exposure. This can be helpful for people with sensitive skin who may experience inflammation from UV exposure.

4. Natural sun protection

Studies suggest that green tea can provide a certain level of UV protection by enhancing the skin's natural defense against sun damage. Although green tea alone is not a replacement for

broad-spectrum SPF, it can complement other sun-blocking agents by adding an extra layer of defense.

5. DNA Repair Support

Green tea's antioxidants, particularly EGCG, may help reduce DNA damage caused by UV radiation, which is associated with skin aging and a higher risk of skin cancer. This protective mechanism may assist in maintaining skin integrity and delaying the visible effects of sun damage.

6. Anti-Aging benefits

The antioxidant and anti-inflammatory qualities of green tea may reduce signs of aging by preventing collagen breakdown and promoting skin elasticity. This is especially useful for people exposed to the sun frequently, as it helps in maintaining younger-looking skin.

❖ **Extraction of green tea**

To extract bioactive compounds from green tea, specific methods are chosen based on factors like purity, target compounds, stability, and the end product application. Here's a detailed overview of some of the key extraction methods for green tea, including materials, equipment, steps, and considerations:

1. Hot water extraction

Steps:

- **Preparation of leaves:** Weigh an appropriate amount of green tea leaves. Typically, 10–15 g of leaves are used for 100 mL of water.
- **Heating water:** Heat water to a controlled temperature (70–85°C). High temperature can degrade some active compounds, so it's essential to maintain an optimal range.
- **Extraction:** Add the leaves to the hot water and steep for a specific time, usually between 10 to 30 minutes, depending on the desired concentration.
- **Filtration:** After extraction, filter the solution to remove the tea leaves. This can be done using filter paper or a fine strainer.
- **Storage:** Store the extracted solution in a dark, cool container to preserve its properties.

2. Ethanol (Alcohol) Extraction

Steps:

- **Preparation of leaves:** Weigh the green tea leaves and crush them lightly to increase surface area.

- **Solvent preparation:** Prepare an ethanol-water mixture (usually 70-90% ethanol, the rest being water).
- **Extraction:** Add the green tea leaves to the ethanol-water mixture and leave them to soak for 1 to 3 days at room temperature or with gentle shaking.
- **Filtration:** Filter the mixture to separate the tea leaves.
- **Evaporation:** Use a rotary evaporator (or allow the ethanol to evaporate naturally) to concentrate the extract by removing excess ethanol.
- **Storage:** Store the final extract in a cool, dark place, ideally in amber glass bottles to prevent light degradation.

❖ **Formulation**

Ingredients	Formulation 1	Formulation 2	Formulation 3
Green Tea extract	-	1ml	2ml
Pomegranate extract	2ml	-	-
Cucumber extract	-	2ml	-
Glycerine	2ml	2ml	2.5ml
Bees wax	3gm	2.5gm	3gm
Rose water	4ml	4.5ml	4ml
Aloe vera gel	2gm	-	1gm
Cocoa butter	2gm	2.5gm	2.5gm
Olive oil	5ml	4ml	4ml
Coconut oil	5ml	5ml	4ml
Turmeric	0.01gm	0.01gm	0.01gm
Arachise oil	-	1.5ml	2ml

❖ **Development of formulation**

Step 1: Melt beeswax and cocoa butter in a china dish after that add coconut oil, olive oil and arachise oil in measured quantities and heat upto 75^{o} C (oil phase).

Step 2: Heat rose water, glycerine, aloevera gel, cucumber extract, pomegranate extract, green tea extract in another china dish in measured quantities and heat upto 75^{o} C (water phase).

Step 3: Now, transfer oil phase into water phase dropwise and continuously stirr the mixture by using homogenizer until a smooth cream is formed at room temperature.

❖ **Evaluation parameters**

✓ **Organoleptic properties**

The appearance and colour are included in the organoleptic property. The pH is measured and was found to be-**6.2** by dilution of cream in water. Viscocity was measured by utilizing

Brookfield viscometer. Cream spreadability was measured with pre distributed methods.

✓ **Sun protection factor**

Sun protection factor (SPF) was measured with a UV-Visible Double Beam Spectrophotometer 2206TS SYSTRONICS. The cream was set on the poly-methyl methacrylate plates were tried. Cream base without UV- retaining agents was utilized for clear check. Three test plates were arranged was kept in dark for 15 minutes for curing. Then the plates were scanned at three distinctive areas and the SPF esteem was recorded.

✓ **Chromatographic assessment**

The substances of beauty care products can be determined and affirmed by chromatography like TLC, HPTLC, HPLC, Gas chromatography.

✓ **Stability studies**

It is carried out at raised temperature, relative humidity and pH a period of 6 months and all over parameters are assessed occasionally to affirm changes in product.

Centrifugation and the freeze-thaw strategy were utilized to test the stability of each herbal sunscreen. For 10 minutes, the centrifugation was carried out at 10000 rpm with 500 rpm interims, and phase partition was watched. All herbal sunscreens were stored at 20°C and 40°C in freeze-thaw research, and phase partition was noted. All of the tests were done three times.

✓ **Microbial test**

As herbal items are delicate to microbial growth, microbial measures was carried out by agar well diffusion method or turbidometric method.

✓ **Physical parameters**

Appearance, color, and homogeneity were determined.

✓ **Determination of viscosity**

The Brookfield viscometer (RVDV-II+PRO) was utilized to test thickness, with the proper number of spindles chosen. A 50 ml beaker was used to hold 50 g of preparation until the spindle groove was plunged and the rpm was set. Herbal sunscreen consistency was measured at 5, 10, 20, 50, and 100 rpm. The thickness was computed utilizing the factor obtained from the reading.

✓ **Determination of pH**

The pH of herbal sunscreens was determined utilizing a digital pH meter. pH was measured after 1 g of the formulation was dissolved in 100 ml of prepared distilled water for 2 hours. The reason of this study was to ensure that the pH of the produced herbal sunscreens is similar to the pH of the skin after 24 hours of utilize. The results were triple-checked, and S.D. was recorded.

✓ **Extrudability study**

The extrudability of herbal sunscreens was determined in this study by calculating the percentage of formulation extruded from the collapsible tube based on the weight in grams necessary to extrude at least 0.5 cm of gel ribbon in 10 seconds. After that, the extrudability was estimated using the formula:

$Extrudability = Applied\ weight\ to\ extrude\ gel\ from\ tube\ (gm)/(cm2)$

✓ **Spreadability**

The spreadability of herbal sunscreens determined their therapeutic proficiency. The appropriate amount of herbal sunscreen was applied between two slides, and under indicates load directions, and the two sides took the time in seconds to slide off. Spreadability was characterized as the amount of time it took to separate two slides in less time.

The formula for calculating it is:

$S = M \times L / t$ Where,

M = weight tied to upper slide. L = length of glass slide.

T = time taken to separate the slides.

✓ **Thermal stability**

The oil division from herbal sunscreens was assessed in a humidity chamber at 60-70 % RH and 37±1°C. A 20 mm wide and 5 mm thick stripe of herbal sunscreens was applied to the internal wall of a 100 ml capacity chamber in its entire heights. The beaker was put away in a humidity chamber for 8 hours at 60-70 % relative humidity and 37°C. There ought to be no oil division in the herbal sunscreen to pass the test.

✓ **Determination of SPF**

A UV Visible spectrophotometer was utilized to examine the in-vitro viability of herbal sunscreens. A 0.10 percent solution (w/v) of herbal sunscreen salves in ethanol was made by dissolving 0.050 g of herbal sunscreen salves in 50.0 ml of ethanol. Between 290 and 320

nm, aliquots of each herbal sunscreen were checked at 5 nm intervals. SPF was calculated using the equation below. Three times each test was analysed.

SPF = CF ∑ EE(λ) × I(λ) × A(λ)

Whereas,

CF= Correction factor;

EE= Erythemogenic effect;

I= Intensity of solar light of wavelength; A= Absorbance;

❖ RESULT AND CONCLUSION

- Herbal Sunscreens aim to provide effective sun protection while minimizing the adverse effects commonly associated with chemical based products.
- It contains natural ingredients like green tea extract, pomegranate extract, cucumber extract, turmeric, aloe vera, rose water which provide safe and gentle protection.
- However, ongoing innovation and education will be crucial in overcoming challenges and ensuring their widespread adoption.

We formulate 3 herbal Sunscreen formulation which are

- Formulation 1
- Formulation 2
- Formulation 3

✓ In **"Formulation 1"** was found to be unstable because it has less viscocity and less SPF value (i.e. 15) due to the presence of pomegranate extract and this extract promotes the fungal growth which makes the **"Formulation 1"** unstable.

✓ In **"Formulation 2"** the stability was better than the **"Formulation 1"** but it is not retained for longer duration. The SPF value of this formulation is 20 which is not capable to protect the skin from UV-rays.

✓ In **"Formulation 3"** the stability, viscocity and spreadability was excellent as compared to above formulations. The SPF value of this formulation was determined (i.e. 34). This SPF value protects the healthy skin from UV- rays.

"Formulation 3" is good because it has high SPF value as compared to other two formulations which makes our sunscreen beneficial to use.

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