FORMULATION AND EVALUATION OF HERBAL SUNSCREEN CREAM CONTAINING TURMERIC AND ALOE VERA EXTRACTS

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ABSTRACT

The sunlight includes dangerous radiations which influence the skin health. Herbal sunscreens resource the body's protection mechanisms to shield against harmful UV radiation from the sun. In the present study, sunscreen creams were formulated with Turmeric extract and Aloe vera extract. Physico-chemical evaluations and in-vitro evaluation was done and of Sun Protection Factor (SPF) were also performed for the formulations. The SPF calculation of prepared cream was done using Mansur equation and was compared with a marketed herbal product. The formulated cream was having good physicochemical characteristics. The SPF evaluation results (SPF-24.888) indicated that the prepared herbal sunscreen has promising sun protection activity.

KEYWORDS: Herbal, Sunscreen, SPF, Skin protection.

INTRODUCTION

Sunscreen, commonly referred to as sunblock or sun cream, is a topical photoprotective treatment for the skin that primarily absorbs or, to a much lesser extent, reflects some ultraviolet (UV) light from the sun. This helps prevent sunburn and, more significantly, skin cancer.

In 1928, the first synthetic sunscreens were used. French chemist Eugène Schueller, the company's founder, released the first significant commercial product to the market in 1936. Franz Greiter invented the first sunscreen in 1938, while Benjamin Green utilised a combination of cocoa butter and red veterinary oil to protect his skin from the sun in 1944. Soon after, Franz Greiter named his product Piz Buin while Mr. Green promoted Coppertone...
Suntan Cream. One of the earliest sunscreen lotions to gain popularity in the United States was created by Florida airman and pharmacist Benjamin Green in 1944 for the navy. At the height of the World War, squaddies in the tropics of the Pacific faced risks from excessive sun exposure.

The phrase "solar safety element," sometimes known as "SPF," is credited to Franz Grieter. Finally, research on the connection between UV light and skin ageing and malignancies was conducted in greater depth. Examples include Albert Kligman's development of the photoaging theory in 1986 or the WHO's 2007 statement about the link between tanning and the onset of skin cancer. Early sun protection strategies included clothing, scarves, and colour. However, the practise of putting cosmetics on the skin to provide additional protection dates back hundreds of years. Various plant-based remedies were utilised in ancient civilizations to help shield the skin from UV damage. No matter what hue their skin is or their pores, dermatologists advise everyone to wear sunscreen with an SPF of at least 30. Dark-skinned people may not burn as quickly, but they are still susceptible to UV damage, including wrinkles and tan spots, as well as cancer.

A few people may experience a mild to moderate allergic reaction to synthetic sunscreen's beneficial ingredients, particularly the molecule benzophenone, also known as phenyl ketone, biphenyl ketone, or benzoyl benzene. Trace levels of benzophenone may be found in urine tests following use, while it's not always apparent how much of it enters the bloodstream. Sunscreens are effective at reducing sunburn, but they no longer consistently reduce the risk of cancer.

When used alone, sunscreen does not offer enough URV protection. Sunscreens make every effort to protect you from sunburn caused by UV-B rays. An exclusive reliance on sunscreen will have the unfavourable effect of increasing the frequency of outdoor exposure, particularly in those who burn easily.

Herbal Sunscreen (Additionally referred to as natural sunblock, herbal suntan lotion) is a lotion, spray, cream, or different topical product that facilitates the defence of the skin from the sun’s ultraviolet (UV) radiation and which reduces sunburn and different pores and skin harm, with the purpose of lowering the chance of skin cancers with the help of herbs.
Benefits of herbal sunscreens

1) Sunscreen protects your skin and reduces your threat of growing pores, skin cancers, and skin precancers.

2) Sunscreen protects each skin kind.

3) When you have a darker complexion, the melanin for your skin gives some protection from sunburns, but you still need to defend your skin from those dangerous ultraviolet rays.

4) Easy availability.

5) No facet consequences

6) No unique equipment is needed for manufacturing.

7) Renewable sources.

SPF: Sun Protection Factor Level

The FDA adopted the term "sun protection factor" to characterise the efficiency of sunscreen as sun burn protection rises with increasing SPF values. A minimal erythema dose is used to quantify the efficiency of SPF in terms of redness (erythema) that develops on redness on the skin. SPF values only represent a sunscreen UVV protection because they are only derived from tests that assess protection against sunburn induced by UVF light. According to the federal registry, SPF is defined as the UV radiation needed to generate medical effects (MED) on skin that has been protected divided by the UVR needed to produce MED on skin that has not been protected.

SPF Protection Level

Low Protection – 6, 10

Medium Protection – 15, 20, 25

High Protection – 30, 40

Very High Protection – 50+

In the US, sunscreen currently needs to provide an SPF rating, which lets users know how well the product blocks UVV rays. The amount of sunscreen used affects how much solar energy is absorbed. Sunscreen application increases reduce solar energy absorption. In order to test the efficiency of SPF, a concentration of 2 mg/cm² is utilised; however, most users only apply between 20 and 50 percent of the recommended dosage. SPF values range from two to more than one hundred. These support the hypothesis that greater SPF protection offers noticeably superior sun protection. Not the period of sunlight exposure you can have
without being sunburned, the SPF value refers to the amount of solar exposure against which the sunscreen offers protections.

SPF can be measured in vitro with the help of a UV-Visible Spectrophotometer. Such in-vitro measurements agree thoroughly with in-vivo measurements.

Mathematically, the SPF is calculated from measured data as follows

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Where, EE(\lambda)- erythemal effect spectrum
I - Solar intensity spectrum
CF- Correction factor (=10)
(\lambda)- wavelength

The values of EE x I are constants and are shown in the table 1

### Table 1: Normalized product function used in the calculation of SPF.

<table>
<thead>
<tr>
<th>Wavelength I(\lambda) in nm</th>
<th>EE x I (normalized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>290</td>
<td>0.0150</td>
</tr>
<tr>
<td>295</td>
<td>0.0817</td>
</tr>
<tr>
<td>300</td>
<td>0.2874</td>
</tr>
<tr>
<td>305</td>
<td>0.3278</td>
</tr>
<tr>
<td>310</td>
<td>0.1864</td>
</tr>
<tr>
<td>315</td>
<td>0.0839</td>
</tr>
<tr>
<td>320</td>
<td>0.0180</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
</tr>
</tbody>
</table>

Aim of this research work was to prepare herbal sunscreen cream by using crude extract of turmeric and Aloe Vera and evaluate the SPF of the formulated product in comparison with a marketed herbal sunscreen cream.

**MATERIALS AND METHODS**

**Materials used**

**Turmeric**

**Biological source:** Turmeric is a flowering plant of the ginger family, Zingiberaceae. Chemical Constituent turmeric includes diarylheptanoids, a class including numerous curcuminoids, such as curcumin, demethoxycurcumin, and bisdemethoxycurcumin.
Aloe-Vera
Aloe vera is a succulent plant species of the genus Aloe belongs to the family Asphodelaceae. Having some 500 species, Aloe is widely distributed, and is considered an invasive species in many world regions.

All the other ingredients such as stearic acid, sodium carbonate, glycerine, potassium hydroxide and alcohol were of analytical grade.

Preparation of turmeric extract: Turmeric rhizomes were collected from Herbal Garden ABIPER, Bangalore. It was cleaned, dried and ground to make the turmeric powder. Crude turmeric extract was prepared by maceration technique. About 15 g of finely ground turmeric power was dissolved in 100 ml of 70% Alcohol. The preparation was left for 48 hours. The filtrate obtained was used to stain the tissues.

Preparation of aloe vera extract: Aloe vera (Aloe barbadensis) plant leaves that were harvested from the herbal garden at ABIPER in Bangalore. The leaves of Aloe vera were gathered, rinsed with water and a moderate chlorine solution, and then were sliced transversely into pieces to create Aloe vera extract, the mucilaginous jelly derived from the centre (the parenchyma) of the plant leaf. The thick skin was carefully peeled off with a vegetable peeler, and the inner gel-like pulp in the leaf's centre was divided with a spoon, chopped, and homogenised in a mixer.

Other materials used
- Stearic acid (17%)
- Sodium carbonate (0.5%)
- Glycerine (6%)
- Potassium hydroxide (0.5%)
- Water (7.1%)
- Alcohol (4.5ml)
- Perfume (0.5ml)

Formulation of herbal sunscreen cream

Table 2: Herbal ingredients used in herbal sunscreen cream formulation.

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Herbal Ingredients</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turmeric extract</td>
<td>10%</td>
<td>5%</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td>Aloe vera extract</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Stearic acid was melted in a China dish. A solution of alkalis (sodium carbonate and potassium hydroxide) in water was made and mixed with glycerine. The aqueous solution was heated. Both the aqueous and oil solutions should be kept at 70°C. Hot aqueous phases was mixed with the molten fat with steady agitation, continuously stirred until emulsification has taken place. Specified amount of turmeric extract and aloe vera extract was mixed along with the cream. Continuous stirring was done until temperature has drop to 40°C. Perfume was dissolved in alcohol and stir. Stirring is continued till a smooth mixture is obtained.

**Evaluation of herbal sunscreen cream**

1. **pH test**
   In order to calibrate the pH metre, standard buffer solution was used. The pH of the cream, which was weighed (0.5gm) and dissolved in 50.0 ml of alcohol, was determined.

2. **Appearance & Homogeneity**
   Physical parameters like colour, odour and homogeneity were examined by visual examination.

3. **Irritancy test**
   Marked a 1 square centimetre area on the left dorsal surface. After applying the cream to the designated area, the time was recorded. Irritation, erythema, and oedema were seen and reported at regular intervals for up to 12 hours.

4. **Spreadability**
   Two glass slides with standard measurements (20 5) were chosen. On a slide, the formulation was visible. The other slide was positioned on top of the cream in such a way that the formulation was sandwiched between the two slides, spaced 7.5 cm apart, and 100 grammes of weight was evenly distributed to make a thin layer. The excess cream that was sticking to the slides was scraped off after the weight was removed. Only the bottom slide was held securely by the opposing fangs of the clamps, allowing the top slide to drop off freely due to the force of the weight linked to it. The two slides were fastened to stand (at a 45° angle) without even the tiniest disruption. Weight measuring 60 grammes was properly fastened to the upper slide. The amount of time needed for the upper slide to move 5 cm and then separate from the lower slide under the influence of weight was recorded. Three repeats of the experiment were conducted, and the mean obtained for these three dimensions was determined. The outcomes were noted. Utilizing the following formula, spreadability is determined:

\[ S = M^*L/T \]
Where S stands for spreadability, L for glass slide length, M for weight attached to the higher slide, and T for time. M is 60 grammes and L is 7.5 centimetres in this experiment.

5. Viscosity
The Brookfield viscometer was used to gauge the viscosity of creams. For the provided product, the appropriate spindle was chosen, and then the working conditions were set up. The viscosity was then directly measured at a speed of 6 rpm while maintaining a constant torque. The median was discovered. The following formula is used to calculate viscosity:

Dial Reading Factor = Viscosity. At 6 RPM, the factor for LV-4 is 1M. (1000)

6. Washability
Washability test was carried out by applying a small amount of cream on the hand and then washing it with tap water.

7. Thermal stability
In this experiment, the oil separation from the cream was examined in a humidity chamber at 60–70% relative humidity and 37–1°C. On the interior wall of the 100 ml chamber’s complete heights, a cream stripe 20 mm wide and 5 mm thick was applied. The beaker was stored in a humidity chamber for 8 hours at a temperature of 37 1°C and a relative humidity of 60–70%. There should not be any oil separation in the cream for it to pass the test. The findings are displayed in a table.

8. SPF determination by in-vitro evaluation
1 g of all sample was measured and weighed, transfer to a 100 ml volumetric flask, diluted with 50 ml ethanol followed by ultra sonification for 5 minute and then filtered through cotton, remove 1st 10ml sample and remaining are collected. The absorption spectra of sample in solution were obtained in the range of 290 to 450 nm using 1 cm quartz cell and ethanol as a blank. The absorption data were obtained in the range 290 to 320, every 5 nm and 3 determinations were made at each point, followed by the application of Mansur equation.

RESULTS
Prepared formulation is shown in figure 1
Physico-chemical evaluation results

Physico-chemical evaluation results are given in table 3

Table 3: Results of physico chemical characterisation.

<table>
<thead>
<tr>
<th>Parameters evaluated</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>The pH of the cream was found to be 6.85</td>
</tr>
<tr>
<td>Colour</td>
<td>The colour of the selected cream was found to be slight yellow in color.</td>
</tr>
<tr>
<td>odor</td>
<td>The odor was not found to be obnoxious. A pleasant odour was obtained</td>
</tr>
<tr>
<td>Homogeneity</td>
<td>Homogeneous. Smooth and consistent.</td>
</tr>
<tr>
<td>• By visual • By touch</td>
<td>Uniform with a value of 42 g.cm/sec.</td>
</tr>
<tr>
<td>Spreadability</td>
<td>Formulations show no redness, edema, inflammation and irritation during irritancy studies.</td>
</tr>
<tr>
<td>Viscosity</td>
<td>Viscosity of the selected formulation was found to be 27361 cps</td>
</tr>
<tr>
<td>Washability</td>
<td>Easily washable</td>
</tr>
<tr>
<td>Thermal stability</td>
<td>No oil separation was observed in the selected formulation</td>
</tr>
</tbody>
</table>

SPF Determination and Comparison

The results of SPF determination of formulated herbal sunscreen Formulation is shown in table 4.
Table 4: SPF evaluation and comparison.

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>EE*I</th>
<th>Absorbance of formulated herbal sunscreen cream</th>
<th>Absorbance of marketed herbal sunscreen cream</th>
<th>SPF of formulated herbal sunscreen cream (F1)</th>
<th>SPF of marketed sunscreen cream (label SPF 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>290</td>
<td>0.015</td>
<td>1.54</td>
<td>1.054</td>
<td></td>
<td></td>
</tr>
<tr>
<td>295</td>
<td>0.08</td>
<td>1.466</td>
<td>1.026</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>0.2874</td>
<td>1.420</td>
<td>1.042</td>
<td></td>
<td></td>
</tr>
<tr>
<td>305</td>
<td>0.3278</td>
<td>1.380</td>
<td>1.066</td>
<td>24.855</td>
<td></td>
</tr>
<tr>
<td>310</td>
<td>0.1864</td>
<td>1.384</td>
<td>1.078</td>
<td></td>
<td></td>
</tr>
<tr>
<td>315</td>
<td>0.0839</td>
<td>1.421</td>
<td>1.015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>320</td>
<td>0.0180</td>
<td>1.480</td>
<td>0.886</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION
The F1 formulation was selected after the physicochemical evaluation. The herbal sunscreen cream F1 was smooth, non greasy and homogenous with a slight yellow colour. The pH is excellent for skin and it didn’t produce any irritation, inflammation or redness. The viscosity of the creams indicates good rheology while handling. Thermal stability studies proves that there is no separation of phase occurred in the given temperature and humidity conditions. Evaluation of SPF of selected herbal sunscreen cream (SPF-24.855) by in-vitro method and comparison with a marketed product (SPF-20.75) indicates that the product is more reliable and suitable.

SUMMARY AND CONCLUSION
In the present research work, we prepared herbal sunscreen cream by incorporating cream base with herbal ingredients such as Turmeric extract and Aloe vera extract to evaluate their efficacy on protecting the skin from sun rays. Formulations such as F1, F2 and F3 were prepared using varying concentration of Turmeric extract (5-15%) and Aloe vera extract (5%) and evaluated for their physicochemical properties and SPF. The study showed that F1 formulation is stable, smooth with best sun protection activity proving a better herbal sunscreen cream. Since the cream was prepared by using simple ingredients and simple methods so the cream is also economical. The herbal cosmetic formulation is safe to use and it can be used as the provision of a barrier to protect skin from sun and also the study reveals that UV Spectroscopy is the rapid, acceptable and reproducible method for the evaluation of efficacy of herbal sunscreens.
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REFERENCE
