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# HERBAL SUNSCREEN: A NATURAL SHIELD AGAINST UV RAYS

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**ABSTRACT**

Rising knowledge of skin health and environmental sustainability has driven the need for natural sunblock solutions. The goal of this study is to create a cosmeceutical sunscreen spray made from organic ingredients that already have Sun Protection Factor (SPF) qualities. The main aim is to create a stable, powerful, and user-friendly sunscreen spray covering wide spectrum while minimizing synthetic chemical use. The spray delivery system was selected to enhance consumer comfort, increase spreadability, and guarantee even distribution. Through sophisticated in-vitro testing techniques, future research could center on increasing the stability of the formulation and guaranteeing ideal viscosity for better spray application. Further study could focus on adapting the formulation so that it produces a light weight and non comedogenic profile but with increased SPF numbers. Studies of the performance of the product on various skin types, including sensitive and acne-prone skin, might help to broaden its usefulness. Furthermore, extended stability evaluations under different environmental conditions might help to shed light on how the shelf life and robustness of the product could be increased. By using the protective qualities of natural ingredients, this research seeks to develop a safe, efficient, and environmentally friendly substitute to conventional sunscreens. The result is projected to help to the expanding area of cosmeceutical research, which is trying to satisfy the demand for sustainable, low-environmental-impact skincare options. This composition holds promise for consumer

preferences as well as dermatologic uses, hence fitting into the increasing trend of organic and natural beauty goods.

**KEYWORD:** (SPF), Sunscreen.

## I. INTRODUCTION

Increased exposure to damaging ultraviolet (UV) rays has severely worried skin health, which has helped to drive demand for reliable sun protection treatments. Skin damage, photoaging, pigmentation abnormalities, and a raised skin cancer risk are all related with long exposure to ultraviolet rays. Modern skincare routines ought to include sunscreen products because of this. But, conventional sunscreens usually use of artificial chemicals that might present hazards such as environmental harm, skin irritation, and questions regarding long-term safety. Therefore, the popularity of creating natural sunscreens that provide safe, powerful, and environmentally friendly options is rising. The growing trend towards natural and organic product has created a need for cosmeceutical Formulation that utilizes natural SPF. Natural SPF agents such as plant extract containing SPF Which offer several advantages over synthetic sunscreen ingredients.

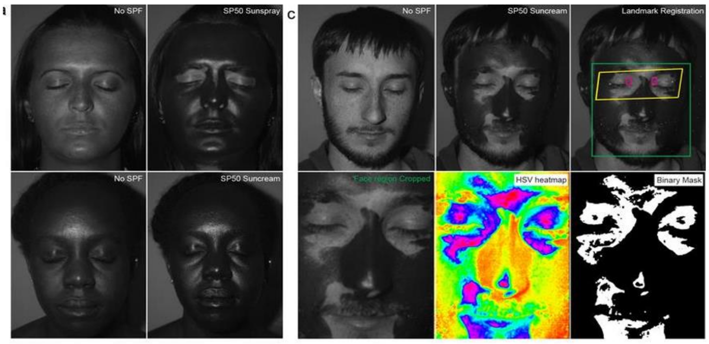
1. Improved skin compatibility: Natural ingredients are often tolerated by skin and less like to cause irritation. Side effects are less likely to appear on skin layer, More effectiveness may result compared with conventional sunscreen.

2. Environmental sustainability: Natural ingredients are biodegradable and non – toxic, Reducing the environmental impact of sunscreen production. Unlike synthetic chemicals, which Can accumulate in water bodies and harm marine life, natural SPF agents break down Harmlessly. This helps preserve ecosystems, including coral reefs, which are often damaged by Synthetic sunscreens. Additionally, sourcing natural SPF ingredients from renewable plant-Based sources supports biodiversity and reduces reliance on fossil fuel-derived compounds. Sustainable farming and ethical harvesting practices further enhance the eco-friendliness of Natural sunscreens, making them a responsible choice for both personal and environment Health.

3. Antioxidant properties: Many natural SPF agents contain powerful antioxidants that help Protect the skin from oxidative stress and damage caused by UV rays, pollution, and free radicals. These antioxidants, such as vitamin C and E, polyphenols and flavonoids, neutralize

harmful Molecules that contribute to premature aging, fine lines and hyperpigmentation. Additionally. They support skin repair by reducing inflammation and boosting collagen production. Promoting a healthier and more youthful complexion. Natural SPF sources like carrot seed oi. Rosemery extract not only provide sun protection but also enhance the skin's resilience against Environmental aggressors.

4. Gentle on sensitive Skin: Natural SPF ingredients are less likely to cause allergic reactions or Irritation compared to chemical sunscreens, making them ideal for sensitive skin.




**Visualization Of Different SPF Level on Skin**

Conventional sunscreen contains synthetic active ingredients, such as oxybenzone and Avobenzone which have high concerns about their potential impact on human health and Environment also titanium dioxide and zinc oxide are used as sun protection material in Sunscreen. But organic compounds like Titanium dioxide and zinc oxide are harmful Chemicals which may associate with skin irritation or cumulative damage titanium dioxide Works as a physical blocker by reflecting UV radiation from skin however these compounds Harm health. As it also damages reproductive health of females.

**The Need Of Organic Sunscreen Components**

Synthetic UV filters such as oxybenzone, octanoate, and avobenzone effectively absorb UV rays are included in many sunscreens commercially available. Still, their effects on human health and the environment have worried experts. Research has revealed that particular chemical filters could result in allergic reactions, hormonal disturbance, and coral reef bleaching, therefore driving legal restrictions in some cases. Consequently, natural options that deliver good sun protection without sacrificing safety are gaining popularity among consumers. Key UV-blocking properties have been shown by natural SPF components like Carrot seed oil, sesame seed oil, and Rosemary. While Carrot seed oil is abundant in carotenoids that protect the skin from UV-induced damage, rosemary is well-known for its wide-spectrum UV defense and antioxidant component. Vitamin E also hydrates and offers moderate SPF protection, whereas Marigold calms the skin and improves its natural barrier activity. Adding antioxidants like Vitamin E in addition to UV protection will help to improve the formulation's effectiveness. These free radicals generated by UV exposure can be neutralized by these antioxidants, therefore lowering oxidative stress and lowering cellular damage. Such versatile components help to create a full cosmeceutical sunscreen formulation providing both sun cover and skin care properties.

**Benefits Of Spray Formulations**

The decision to create a spray formulation comes from its many benefits compared to regular sunblock distribution systems. Spray formulations enable better spread so that even distribution over great surface areas is possible. Outdoor activities especially profit from this trait, since speedy and simple reapplication is absolutely necessary. Furthermore, spray sunscreens are usually quick absorbing, light weight, non-greasy products that appeal to people who want little to no left behind and a pleasant skin feel. Moreover, spray formulations streamline the application process, therefore improving user compliance. Studies have revealed that many people underuse regular creams and lotions, therefore lessening their overall protection. The spray's fine mist guarantees even dispersal, so increasing the performance of the merchandise.

**Goals Of Investigation**

This study's main goal is to create a cosmeceutical sunscreen spray formulation based on natural SPF components. To guarantee good sun protection and user contentment, the formulation will be fine-tuned for stability, viscosity, and sensory qualities. Important goals consist in: finding and choosing organic ingredients with confirmed SPF benefits. Developing a stable and uniform sunscreen spray with suitable viscosity for efficient use. Evaluating the effectiveness of the product using in-vitro SPF testing. Evaluating consumer-relevant elements including texture, absorption rate, and non-comedogenic features. Ensuring product longevity entails running stability studies under different environmental conditions.

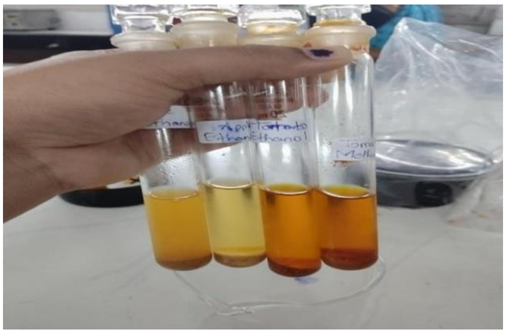
## II. MATERIALS AND METHODS

**Preparation Of Plant Material**

**1. Extraction of Materials**: Lycopene, Phytoene and Phytofluene was extracted from Tomatoes, Resveratrol was extracted from Grapes (Black and Red grapes were used) Luteolin was obtained from Apples, SPF content for sunscreen was obtained from Rosemary and Marigold, Lignin was obtained from Sesame Seeds (sesame seed oil was used), Carrot seed oil was obtained from carrot seeds.

**1a. Extraction Of (Lycopene, Phytoene and Phytofluene) From Tomato:** Tomatoes were dried in laboratory Hot Air Oven at 80°C for 2 days. The dried tomatoes were then crushed and then extract was obtained by using Rotary shaker overnight for 48hours (1g tomato powder in 10ml ethanol and 10ml methanol).

**1b. Extraction Of Luteolin from Apple**: For Luteolin extraction Apples were dried using Laboratory Hot Air Oven at 80°C for 2 days. The Dried apples were then crushed and then extract was obtained by using Rotary Shaker overnight for 48hours (1g apple powder in 10ml ethanol and 10ml methanol).

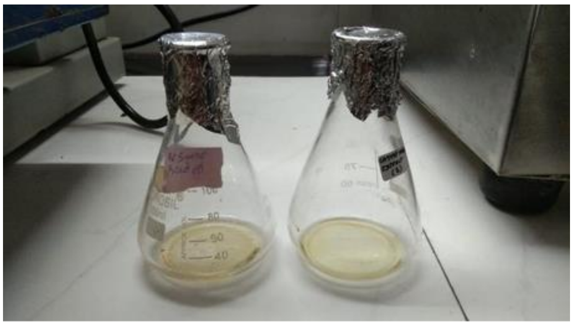


**Phytochemical Extraction**

**1c. Extraction Of Resveratrol from Grapes (Black & Red):** Resveratrol was obtained from grapes by composition of Ethyl acetate: Formic acid: Acetic acid: H2O at the ratio of (20:3: 3:5) Maceration extraction technique was used for extracting resveratrol. 10ml Black grapes paste in 50 ml chloroform and 50ml ethanol, same 10ml Red grapes paste in 50ml chloroform and 50ml ethanol.

**1d. Extraction Of Lignin from Sesame Seeds:** Lignin was extracted from sesame seeds using Soxhlet Apparatus. Sesame seeds were washed and dried at 75°C for half hour. Further 5g of Sesame seeds were taken into 150ml pet ether at 60°C for 3 days. And then sesame seeds oil was extracted using Water bath by boiling method.

**Soxhlet Of Sesame Seeds**



**Extraction Of Lignin From Sesame Seeds And Oil From Carrot Seed**

**1e. Extraction Of Carrot Seed Oil From Carrot Seed:** Carrot seed oil was extracted by using Soxhlet Apparatus. Carrot seed were washed and dried at 75°C for half hour and crushed and formed into powder state. Further 4.125g of carrot seed powder in 150ml of pet-ether at 60°C for 3 days. After then carrot seed oil was extracted using Water bath by boiling method.

**1f. Extraction of SPF Content from Rosemary And Marigold:** Rosemary and Marigold having a natural SPF content. The SPF was extracted using boiling method Rosemary leaves and Marigold flower petals were boiled in 150 ml water at 58°C for 45 minutes and then the extract was used during formulation.

**1g. Extraction Of Rose Water:** Rose was boiled in Water Bath at 55°C for 40 minutes. Rose water was used for Fragrance and it contains Anit-oxidant properties.

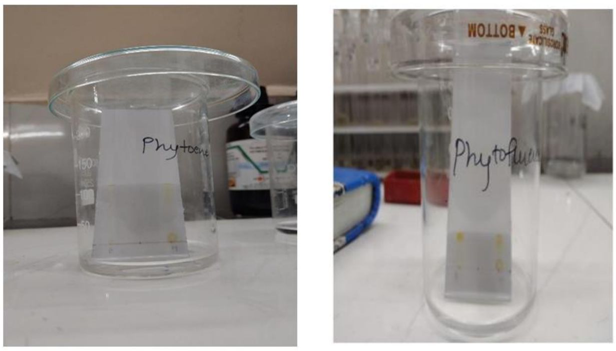
**Rose Petals And Marigold In Water Bath**

**2. Phytoconstituents Test Table**

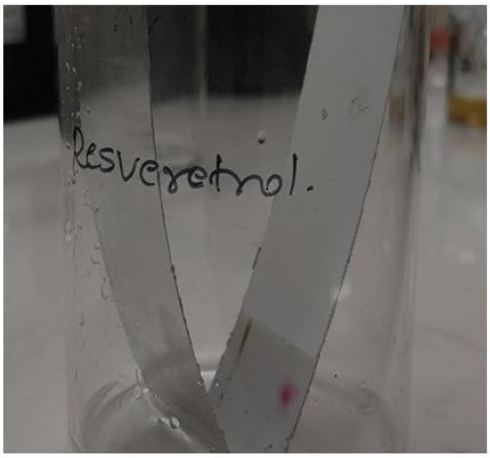
| TEST | PROCEDURE | INFERENCE | RESULT |
|---|---|---|---|
| Alkaloids | 0.1ml of extract + Mayers reagent | Cream Precipitate | Present |
| Tannins | Extract + Freshly prepared fecl3 | Brownish/Black color | Present |
| Terpenoids | Extract + 2ml CHCl3 +H2SO4 | Reddish Brown Color | Present |
| Flavonoids Test 1<br>Test 2 | Extract + Diluted NH3+ Concentrated H2SO4 Extract + Diluted NH | Yellow coloration | Present |
| Saponins | Extract + Olive Oil | Emulsion happens | Present |
| Ascorbic acid | Extract + Na2CO3 + pinch of Feso4 +5ml of H2SO4 | Greenish-black color precipitate | Present |
| Glycosides Test 1<br>Test 2 | Extract+ Fehling's A&B Extract + Fehling's A&B | A Brick red precipitate | Present |

**3. Thin Layer Chromatography**

Materials and Reagents Silica gel TLC plates, analytical-grade solvents including hexane and acetone, sample compounds (Lycopene, Phytofluene, and Phytoene), capillary tubes for sample application, a TLC chamber, were used. Each developing chamber was saturated with the respective mobile phase for 15–30 minutes before TLC plate placement. The plate was positioned upright in the chamber, ensuring the baseline remained above the solvent level. The mobile phase was allowed to ascend the plate via capillary action until the solvent front reached approximately 70–80% of the plate height. The plate was then removed, dried, and marked for further analysis.



**Presence Of Phytofluene and Phytoene In Tomato Extract**




**Presence Of Resveratrol in Grapes Extract**

**4. UV Analysis**

UV-Vis Spectroscopic Analysis 1. The spectrophotometer was calibrated using a blank solvent (distilled water) before measurements. 2. Each sample was placed in a quartz cuvette and analyzed at 400 nm wavelength. 3. Absorbance values were recorded for each sample. 4. Spectral data were collected and compared to determine differences in light absorption among the samples. Data Interpretation The absorbance readings were used to evaluate the presence and concentration of pigments and polyphenolic compounds in the samples. Variations in absorbance indicated differences in the composition of bioactive compounds, such as flavonoids, carotenoid.

**5. Molecular Docking**

**Software and Materials**

Molecular docking studies were performed using PyRx (AutoDock Vina). The following protein-ligand pairs were selected for docking analysis:

• Protein 1K8J with Ligand 35370 • Protein 6DGT with Ligand 5280445 • Protein 7KZF with Ligand 56840728 • Protein Cyclophilin A with Ligand 65064.

The protein structures were obtained from the RCSB Protein Data Bank (PDB), while the ligands were retrieved from PubChem. Additional tools, including Discovery Studio and LigPlot+, were employed for post-docking analysis and visualization of molecular interactions.

**Protein and Ligand Preparation**

**Protein Preparation**

1. The crystal structures of the target proteins were downloaded in PDB format from the RCSB PDB database.
2. Using PyRx, non-essential molecules, including water and bound ions, were removed to prevent interference with docking calculations.
3. Each protein was converted to PDBQT format within PyRx to facilitate docking.

**Ligand Preparation**

1. The ligand structures were retrieved from PubChem in SDF format and imported into PyRx.
2. Ligands underwent energy minimization to achieve a stable conformation.
3. Each ligand was converted to PDBQT format, ensuring compatibility with AutoDock Vina**.**

**Molecular Docking Procedure**

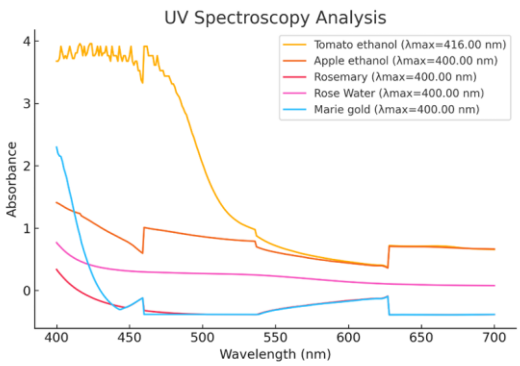
1. The docking simulations were performed using AutoDock Vina within PyRx.
2. The active binding site for each protein was identified based on prior literature or the position of co-crystallized ligands.
3. A grid box was defined around the binding site to ensure accurate docking calculations.
4. Docking was conducted with an exhaustiveness parameter set to 8 to optimize ligand conformations.

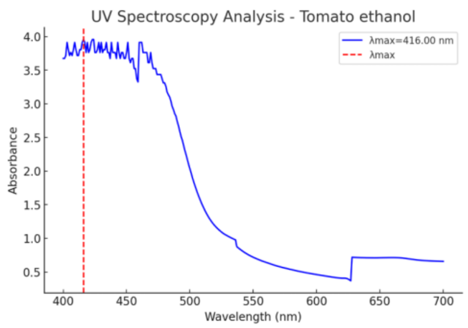
**III. RESULT AND DISCUSSSIONS**

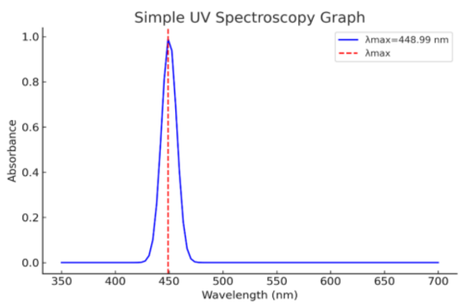
The formulation of a natural sunscreen spray using extracts from rosemary, marigold, sesame seeds, carrot seeds, apple, tomato, and grapes demonstrated its potential as an effective, eco friendly, and user-friendly alternative to synthetic sunscreens. The spray showed moderate absorptivity in skin attributed to bioactive compounds like carotenoids, flavonoids, polyphenols, which are known for their UV-absorbing and antioxidant properties. Rosemary and marigold extracts were the key contributors, with marigold offering strong UVB and UVA protection due to its high carotenoid content, while rosemary provided potent antioxidant activity to combat UV induced oxidative damage. The UV ranges significant for sunscreen spray formulation are UVA (nm), UVB (nm). Sesame oil enhanced the formulation by acting as a natural emollient and stabilizer, ensuring good skin compatibility. The spray formulation was easy to apply, offering even coverage and a non greasy, lightweight feel, with a pleasant herbal fragrance from the natural extracts. though slight color changes due to carotenoid oxidation were noted. While the SPF was moderate compared to synthetic alternatives, the formulation provided additional benefits such as skin hydration, environmental safety, and consumer appeal.

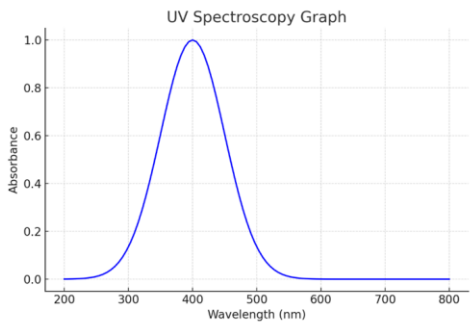
**Table 1: Result Of Phytochemical Analysis (-) Absent (+) Present.**

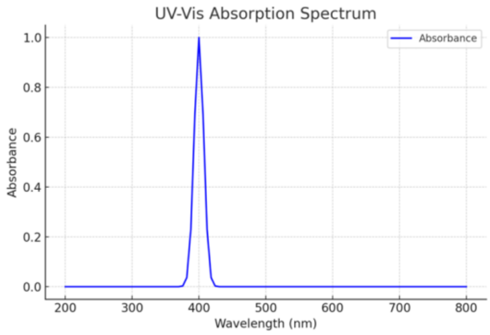
| TEST | INFERENCE | RESULT |
|---|---|---|
| Alkaloids | Cream Precipitate | + |
| Tannins | Brownish / black colour | + |
| Terpenoids | Reddish brown colour | + |
| Flavonoids Test 1 and Test 2 | Yellow coloration | + |
| Saponins | Emulsion happens | + |
| Ascorbic acid | Greenish – black colour precipitate | + |
| Glycosides Test1 and Test 2 | A brick red precipitate | + |

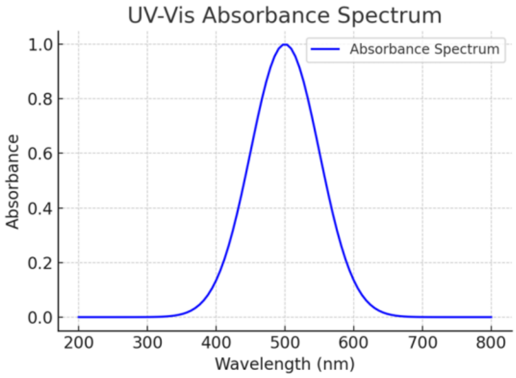





## IV. CONCLUSION

This research focuses on the formulation and evaluation of a natural sunscreen spray using rosemary, marigold, grapes, sesame seeds, carrot seeds, apple, and tomatoes, which are rich in flavonoids, carotenoids, polyphenols, and essential fatty acids known for their UV-protective, antioxidant, and skin-nourishing properties. The active compounds were extracted using Soxhlet extraction for heat-stable bioactive like carotenoids and flavonoids from sesame seeds, carrot seeds, and rosemary, while the water bath method was used for delicate antioxidants from marigold, grapes, apple, and tomatoes. The extracts were tested using phytochemical screening to confirm key bioactive constituents, followed by thin-layer chromatography (TLC) for compound identification, UV ranges are obtained for the taken samples, and molecular docking studies to evaluate and visualize the binding interaction between the extracted bioactive compounds and target proteins associated with UV protection. The docking studies provided insights into the molecular mechanisms of sunscreen efficacy by confirming the affinity of key compounds for UV-related proteins, further validating their protective potential. UV absorbance readings of the individual extracts were also performed to quantify their UV-blocking capacity, further contributing to the understanding of their SPF contribution.

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