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Formulation and Evaluation of Herbal Sunscreen Lotion Enriched with Natural Plant Extracts

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ABSTRACT

Background: Prolonged exposure to ultraviolet (UV) radiation may result in sunburn, accelerated aging, cutaneous damage, and potentially, carcinoma of the skin. While effective, synthetic sunscreens are frequently linked to dermal irritation and possible toxicity. Herbal sunscreens, formulated with natural, plant-derived compounds, present a more secure and ecologically sound alternative. **Objective:**To develop and evaluate a herbal sunscreen lotion utilizing plant extracts possessing established UV-protective, antioxidant, and skin-soothing properties. **Materials and Methods:** Herbal extracts derived from Aloe vera, Watermelon, Sandalwood, and Turmeric were selected based on their photoprotective and antioxidant capabilities. The lotion base was prepared utilizing conventional emulsification methodologies. Physicochemical properties, including pH, viscosity, spreadability, and stability, *in-vitro* sun protection factor determined via UV spectrophotometry were evaluated for the formulated herbal sunscreen lotion. **Results:** The herbal sunscreen lotion exhibited acceptable spreadability, stability under diverse storage conditions, and an appropriate pH (5.5–6.5). Confirmation of effective UV-B protection was established by the moderate range (SPF 15–25) of the *in-vitro* SPF value. The presence of significant antioxidant activity suggested the potential for skin protection from oxidative damage. **Conclusion:** The herbal sunscreen cream exhibits potential antioxidant properties in conjunction with ultraviolet (UV) protection. It serves as a safe, natural, and efficient alternative to chemical sunscreens, demonstrating commercialization potential.

Key Words:

Herbal sunscreen, UV protection, Sun Protection Factor, Aloe vera, Watermelon, Turmeric

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I. INTRODUCTION:

Sunscreen, a cream or liquid preparation, is applied to the skin to protect it from the sun's detrimental rays and to prevent sunburn. In addition to being available as a spray, lotion, gel, foam stick, or other topical substance that either absorbs and helps to prevent sunburn or reflects a portion of the sun's ultraviolet (UV) rays, sunscreen is also recognized as sun blocks, suntan lotion, or sun-cream. UVA and UVB radiation constitute the primary active components of ultraviolet

(UV) radiation. The efficacy of sunscreen in filtering UVB rays and those that cause sunburns and tanning is determined by its sun protection factor, or SPF. The majority of recently developed sunblock formulations also provide UVA protection [1].

The epidermis, dermis, and sebaceous glands constitute the three primary layers of human skin. As the outermost layer, the epidermis acts as a barrier against UV rays and is water-resistant. Various synthetic and natural formulations are available to shield the skin from harmful UV rays, preventing tanning and damage. This sunscreen lotion contains herbal ingredients such as watermelon, sandalwood, turmeric, and aloe vera [2]. Through the reflection or absorption of the sun's ultraviolet (UV) radiation, sunscreen, also recognized as sun block or sun-tanning lotion, operates as a topical lotion, thereby effectively preventing skin cancer. Additionally, it serves to protect the skin from sunburn. A diverse selection of sunscreens are accessible for topical application, encompassing lotions, gels, sprays, foams (including whipped or expanded foam lotion), powders, and sticks, inter alia. In conjunction with apparel, sunscreen is frequently employed, particularly with sunhats, sunglasses, and specifically designed sun-protective garments Protective measures also encompass the use of umbrellas. Herbal sunscreen lotions, for example, serve as a topical treatment that safeguards the skin from ultraviolet radiation, while also mitigating the risks of sunburn and other forms of skin damage [3]. However, the utilization of synthetic chemicals has historically been detrimental to both human health and the environment. Extensive research has demonstrated that numerous chemicals, dyes, synthetic materials, and their derivatives can induce a wide array of skin conditions, resulting in a multitude of adverse effects. Therefore, we prioritize the use of natural cosmetics whenever possible [4]. The global market presents an array of sunscreen products, encompassing oils, sticks, gels, creams, and lotions. These products necessitate the incorporation of sunscreens that provide adequate protection against UVA and UVB radiation. Sunscreens are categorized into two primary types: chemical and physical. Chemical sunscreens function by absorbing UV radiation, whereas physical sunscreens serve as a temporary protective barrier, reflecting harmful rays away from the skin [5]. A fifth type of sunscreen consists of both organic and inorganic filters. Chemical sunscreens act as physical barriers, absorbing high-energy UV photons and reflecting or scattering them. In contrast to chemical sunscreens, organic molecules offer protection against a broader spectrum of UV rays. Organic filter components absorb specific ultraviolet (UV) light wavelengths, a function of their chemical composition. The filter transitions from a low-energy to a high-energy state. Inorganic filters scatter and reflect UV rays back into the environment. Inorganic filters also act as physical barriers to UV radiation. Because inorganic filters cover the entire UV spectrum, they are considered broad-spectrum. Common examples of inorganic filters include zinc oxide and titanium dioxide [6].

Many individuals may experience skin hypersensitivity, leading them to avoid chemical sunscreens due to concerns regarding potential skin exposure to unknown substances. While a range of hypoallergenic cosmetic products are available for those with sensitive skin, options for sunscreen agents remain limited.

Consequently, the development of herbal-based sunscreen products that are both efficacious and possess minimal or no adverse effects is being sought. Herbal extracts in their entirety are composed of diverse chemical compounds that synergistically enhance skin health. Chemical analyses have demonstrated that these plants are rich sources of flavonoids, glycosides, and linoleic acid. Presently, there is considerable interest in the utilization of natural compounds

capable of absorbing ultraviolet radiation due to the benefits associated with products containing these compounds and consumer adherence to their use [7]. Herbal components utilized in cosmetic formulations exhibit a range of beneficial properties, including antibacterial, antiseptic, anti-inflammatory, and antioxidant characteristics. Furthermore, herbal products are often associated with fewer adverse effects when compared to their synthetic counterparts. It is important to note that all skincare products, such as lotions, creams, and shampoos, are encompassed within the cosmetic product classification. A substantial quantity of herbal ingredients is employed for cosmetic purposes, often designated as "herbal cosmetics." The escalating demand for herbal remedies can be attributed to the negligible presence of adverse effects. Herbal cosmetics are exclusively composed of herbs and shrubs. Substances extracted from natural herbs do not induce any deleterious effects on human skin [8].

SPF:

The numerical value associated with SPF, representing Sun Protection Factor, functions as an indicator of a sunscreen's capacity to safeguard the skin from sunburn. A sunscreen possessing a higher SPF rating and broad-spectrum coverage provides enhanced protection against sunburn, UVA radiation, and DNA damage, in contrast to products with lower SPF values, particularly under optimal conditions, such as those found in a laboratory environment [1].

Importance of Sunscreen

Ultraviolet radiation is essential for human physical health, as it facilitates vitamin D3 production and the intestinal absorption of calcium and phosphorus. Conversely, these radiations can negatively impact human health through direct interactions with proteins, lipids, DNA, and RNA, potentially leading to cancerous outcomes. Therefore, the application of topical substances with UV-absorbing or UV-reflecting properties represents the most effective method for shielding the skin from harmful UV radiation. Therefore, the application of sunscreen has become increasingly important in the present context. The utilization of sunscreen constitutes one of the most accessible and effective methods for maintaining the appearance and well-being of one's skin throughout all stages of life. When consistently applied, sunscreen functions to mitigate the effects of premature aging, skin melanoma, and UV damage. To facilitate the incorporation of sunscreen into one's daily regimen [9].

Utilizing chemical processes, synthetic products are composed of substances that have been chemically altered and derived from naturally occurring minerals, plants, and animals. Certain products pose an increased risk of skin cancer. However, in contrast to synthetic makeup, which has adverse effects, herbal cosmetics preserve skin integrity, enhance its appearance, and provide essential nutrients. Numerous plant sources that promote healthy skin have been identified by ancient scholars [10].

The current study employs extracts from different plant materials, including watermelon (*Citrullus lanatus*), sandalwood (*Santalum album*), aloe vera (*Aloe barbadensis*), and turmeric (*Curcuma longa*), at various concentrations, with the objective of developing sunscreen lotions that exhibit a broad spectrum of anti-UV radiation effectiveness while minimizing the concentration of chemical UV filters. The primary physicochemical property and biological activity utilized to evaluate the efficacy of the products was the Sun Protection Factor (SPF).

II. MATERIALS AND METHODS

Plant material: The ingredients for the formulation, including watermelon (*Citrúllus lanatus*), sandalwood (*Santalum album*), Aloe vera (*Aloe barbadensis*), and turmeric (*Curcuma longa*), were sourced from a nearby market close to Supela, Bhilai, Chhattisgarh, India.

Materials and chemicals required: The employed chemicals and reagents included stearic acid, liquid paraffin, glycerin, triethanolamine (TEA), methyl paraben, 99% methanol, and ethanol. These were obtained from the Shri Shankaracharya College of Pharmaceutical Sciences in Bhilai, and all solvents were of analytical grade.

Instruments: The analytical instruments employed were a pH meter (Systronics, India), a Brookfield viscometer [DV-I, LV-I spindle, Brookfield Engineering Laboratories, USA], a muffle furnace [77 S8HT8, Tempo, India], a micro centrifuge [RM-12CDX, Remi, India], a deep freezer [RQF 650, Remi, India], and a UV-visible spectrophotometer [UV 1780, Shimadzu, Japan].

Preparation of crude extracts:

The three plants selected for the sunscreen lotion were chosen based on research conducted from studies [11-19]. Various extraction methods were utilized, as described in detail below:

Watermelon (*Citrullus lanatus*) Extraction

The watermelon extract is obtained through a process involving maceration of fruit components within a hydro-alcoholic solution, followed by filtration and concentration using a rotary evaporator [20-21]. The extraction of watermelon is shown in Fig. 1.

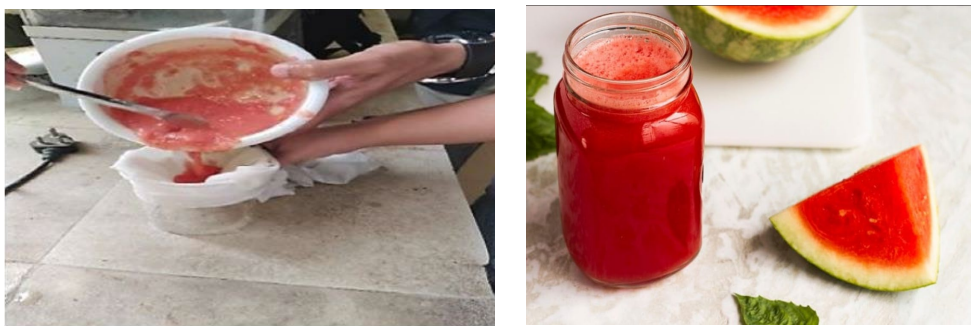

Fig. 1: Extraction of watermelon

Turmeric (*Curcuma longa*) Extraction

Turmeric extract was procured using 70% ethanol as the extraction solvent. The extract was then integrated into sunscreen lotion formulations at different concentrations. These formulations were evaluated for their physical attributes, such as pH, viscosity, spreadability, drying time, and adhesiveness, as well as their *in vitro* SPF values [14]. The extraction of turmeric is shown in Fig. 2.

Fig. 2: Turmeric extract

Aloe Vera (*Aloe barbadensis*) Extraction

Aloe vera leaves were harvested and rinsed with water and a diluted chlorine solution. They were then sliced to create Aloe vera extract, the mucilaginous jelly from the plant leaf's core (parenchyma). The thick skin was carefully removed with a peeler, and the inner, gel-like pulp was divided with a spoon, chopped, and homogenized in a mixer [11-13]. The extraction of aloevera is shown in Fig. 3.

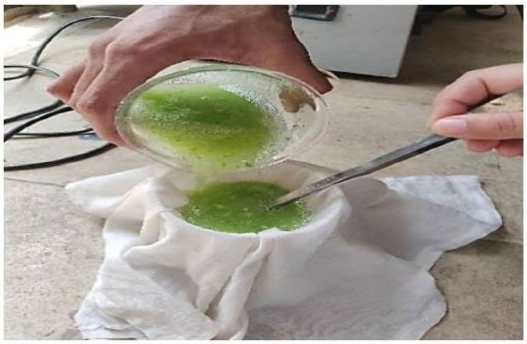

Fig. 3: Aloe vera extract

Phytochemical screening of various extracts:

Phytochemical screening is conducted to identify secondary metabolites in the extracts, which will then be examined. This screening was performed on extracts from watermelon (*Citrullus lanatus*), Aloe vera (*Aloe barbadensis*), and turmeric (*Curcuma longa*). The screening of watermelon, aloe vera, and turmeric extracts encompasses the phytochemical examination of polyphenol compounds, alkaloids, flavonoids, sesquiterpenes and monoterpenoids, steroids and triterpenoids, tannins, saponins, and quinones [22-25].

Formulation of herbal sunscreen lotion: The preparation of herbal sunscreen lotion involves several steps [11,13,22-23]. Table 1 outlines the ingredients and their quantities required for the formulation of 100 gm of the lotion.

Step 1: Aqueous Phase Preparation

Introduce distilled water into a beaker, and heat it to a temperature range of 75–80°C. Subsequently, incorporate aloe vera gel, glycerine, and watermelon extract into the water, ensuring thorough mixing until a homogenous solution is achieved. Prepare a fine slurry using sandalwood powder or, alternatively, a decoction (filtration may be required), and introduce it into the mixture. Finally, integrate turmeric extract into this phase, maintaining the solution's temperature at approximately 75°C.

Step 2: Oil Phase Preparation

Within a designated beaker, introduce coconut oil (or jojoba oil, specifically in formulation F3), almond oil, shea butter, stearic acid, and cetyl alcohol. Subsequently, the resultant mixture should be heated to a temperature range of 75 to 80°C, ensuring the complete amalgamation of all components. Micronized zinc oxide should then be introduced gradually, with continuous agitation to facilitate uniform dispersion and to prevent any aggregation. Finally, the temperature must be maintained at the same level as the aqueous phase to optimize emulsification.

Step 3: Emulsification

Introduce the oil phase gradually into the aqueous phase while maintaining constant agitation using either a mechanical stirrer or a homogenizer. Subsequently, stir the mixture for approximately 10 to 15 minutes, or until a homogenous emulsion or lotion is achieved.

Step 4: Cooling and Addition of Actives

Cool the emulsion to approximately 40°C. Then, add Vitamin E (tocopherol acetate), sandalwood essential oil, and either phenoxyethanol or a herbal preservative (as detailed in Table 1). Finally, adjust the pH to approximately 5.5–6.5 using TEA (Triethanolamine) or NaOH solution, confirming with a calibrated pH meter.

Step 5: Final Mixing and Packaging

Introduce gentle agitation for an additional period of 5-10 minutes, ensuring complete uniformity of the lotion. Subsequently, dispense into sterile, opaque containers to provide protection from light and to prevent contamination. Finally, label and store in a cool, dry location.
A total of three formulations, F1, F2, and F3, were prepared using various formulas (Table 1).

Table 1: Composition of various herbal sunscreen formulations

Ingredients	Function	Formulation 1 (%)	Formulation 2 (%)	Formulation 3 (%)
Aloe vera gel (*Aloe barbadensis*)	Moisturizing, soothing	10.0	8.0	12.0
Watermelon extract (*Citrullus lanatus*)	Antioxidant, hydration	3.0	5.0	4.0

Sandalwood powder (*Santalum album*)	Anti-inflammatory, aromatic	2.0	2.0	3.0
Turmeric extract (*Curcuma longa*)	UV absorption, antioxidant	1.0	1.5	2.0
Distilled water	Solvent	47.0	43.0	40.0
Stearic acid	Emulsifier, thickener	2.5	2.0	2.0
Cetyl alcohol	Co-emulsifier	1.5	1.5	1.5
Glycerin	Humectant	4.0	4.0	4.0
Coconut oil	Emollient, SPF enhancer	4.0	2.0	—
Almond oil	Skin nourishing, natural SPF	4.0	3.0	5.0
Jojoba oil *(replacing coconut in F3)*	Sebum mimic, non-comedogenic	—	—	4.0
Shea butter	Emollient, improves spreadability	3.0	3.0	3.0
Zinc oxide (micronized, non-nano)	Physical UV filter	5.0	7.0	7.0
Vitamin E (Tocopherol acetate)	Antioxidant, skin conditioning	0.5	0.5	0.5
Phenoxyethanol or herbal preservative	Microbial stability	0.5	0.5	0.5
Essential oil (Sandalwood)	Fragrance, soothing	0.5	0.5	0.5
pH adjuster (TEA/NaOH)	Adjust to 5.5–6.5	q.s.	q.s.	q.s.

Evaluation test for lotion

Spread ability: Two glass plates were selected. The gel was applied to one side of a slide, and the second slide was positioned on top, resembling a sandwich. The slides were secured, enabling the upper slide to detach. The time required for the slides to separate was calculated using the formula

$$S=W*LT$$

Where, S= Spreadability, L= length of the glass plate, W=Weight tied to upper plate, T= Time taken for the two plates to get separated

pH: 1g of gel was dissolved in 10ml of water, and the pH was measured using a pH meter.

Viscosity: The viscosity of the lotion was determined using a Brookfield viscometer equipped with a spindle.

Consistency: The product's consistency was assessed manually.

Grittiness: The lotion was applied to the palm to check for any gritty particles.

Washability: The gel was applied to the hand and washed off under running water.

Irritancy Test: An irritancy test is crucial in sunscreen evaluation. Topical constituents, sometimes causing adverse reactions or hypertension, can lead to skin edema and erythema. Since we are using herbal products, irritants may be present; therefore, a regular 24-hour irritancy test should be conducted and reported.

Erythema

0 - No Erythema

1 - Small Erythema

2 - Visible Erythema

3 - Medium Erythema

4 - Severe Erythema

Edema "junking" Test: Sunscreen will be applied to the skin, such as on the face, hands, and legs, among other areas. Therefore, it should easily "junk" (remove/wash off) after use. Easy removal enhances the convenience of using the sunscreen, so a "junking" test should be conducted and reported.

Feel: In this test, we will apply the sunscreen directly to the skin to determine its feel. After application, we will assess any burning or cooling sensations. Emollience and greasiness will also be checked and reported.

Determination Sun Protection Factor (SPF) in UV- Spectrophotometer

First, expose the skin to the sun and note the time it takes to develop a slight sunburn. Then, apply a small amount of sunscreen and observe the time it takes for erythema to appear.

Then calculate the ratio of both the time

SPF = Time taken to form an erythema with sunscreen
Time taken to form an erythema without sunscreen.

III. RESULTS AND DISCUSSION

Phytochemical Analysis of Herbal extract: The phytochemical analysis of various herbal extracts from watermelon (*Citrullus lanatus*), aloe vera (*Aloe barbadensis*), and turmeric (*Curcuma longa*) is presented in Table 2.

Table 2: Phytochemical screening of various extracts

Phytochemicals	Watermelon Extract (*Citrullus lanatus*)	Aloe vera Gel (*Aloe barbadensis*)	Turmeric Extract (*Curcuma longa*)
Alkaloids	−	−	+
Flavonoids	+++	++	+++
Phenols	++	+++	+++
Tannins	+	+	+
Saponins	−	+++	+
Glycosides	+	+++	++
Terpenoids	+	+	+++
Steroids	−	+	+
Coumarins	−	+	+
Carbohydrates	+++	+++	+

+++ = Strongly present, ++ = Moderately present, + = Slightly present, − = Absent

Evaluation test: The results for various evaluation parameters, including SPF analysis, pH, viscosity, spreadability (g·cm/sec), stability (appearance, phase separation), washability, feel test, skin irritation, and sensory evaluation, were reported in Table 3.

Table 3: The various test parameters for evaluation of herbal sunscreen lotion

Parameter	Test Method / Instrument	Formulation 1 (F1)	Formulation 2 (F2)	Formulation 3 (F3)
Sun Protection Factor (SPF)	UV spectrophotometric (in vitro)	18.5 ± 0.5	24.3 ± 0.4	20.1 ± 0.6
pH	Digital pH meter (at 25°C)	6.1 ± 0.2	6.4 ± 0.1	5.8 ± 0.1
Viscosity (cPs)	Brookfield Viscometer (spindle 4, 10 rpm)	3200 ± 50	3400 ± 60	3100 ± 45
Spreadability (g·cm/sec)	Glass slide slip-and-drag method	6.8 ± 0.2	6.2 ± 0.3	7.1 ± 0.2
Stability (appearance, phase separation)	Accelerated (40°C, RT, 4°C) – 30 days	Stable	Stable	Stable
Washability	Rinse-off test with water	Moderate	Low (resistant)	Moderate
Feel test	Feel on the skin	Cool sensation	Cool sensation	Cool sensation
Skin Irritation (Patch test)	Volunteer-based observation	None	Mild (in 1/10)	None
Sensory Evaluation (Avg. Score)	Texture, fragrance, absorption (1–5 scale)	4.2	3.9	4.5

IV. DISCUSSION

The three herbal sunscreen lotion formulations were subjected to development and evaluation, with assessments performed on their physicochemical, functional, and sensory attributes to ascertain their suitability for topical application and photoprotective capabilities.

SPF Analysis:

F2 demonstrated the maximum SPF value (24.3 ± 0.4), potentially attributable to the elevated concentration of zinc oxide and turmeric extract, both recognized for their potent UV-blocking and antioxidant characteristics. F1 (SPF 18.5 ± 0.5) offered moderate protection, suitable for routine application, whereas F3 presented a balanced SPF (20.1 ± 0.6), which is appropriate for mild to moderate sun exposure.

pH and Skin Compatibility:

Those formulations displayed pH values that fell within the skin-compatible spectrum, from 5.5 to 6.5. F3 registered the lowest pH reading at 5.8 ± 0.1, potentially making it well-suited for those with sensitive or acne-prone skin, whereas the remaining formulations showed somewhat more neutral pH levels.

Viscosity and Spreadability:

F2 exhibited the greatest viscosity, measuring 3400 ± 60 cPs, leading to enhanced film formation and water resistance, thus making it suitable for extended outdoor applications. Conversely, it displayed the poorest spreadability at 6.2 g·cm/sec, potentially impacting user experience. In contrast, F3, which substituted coconut oil with jojoba oil, demonstrated superior spreadability, registering 7.1 ± 0.2 g·cm/sec, and resulted in a more refined application.

Stability and Safety:

The formulations consistently maintained physical stability for 30 days under expedited conditions. Patch tests showed no negative reactions in F1 and F3, whereas F2 elicited a single instance of mild irritation, potentially linked to its increased turmeric concentration or essential oil levels.

Sensory Characteristics:

Among the formulations, F3 received the best user acceptability rating of 4.5 out of 5, which can be attributed to its comfortable texture, easy absorption, and gentle scent. F1 also performed well, with a rating of 4.2/5. Conversely, F2, despite its superior performance, had a lower sensory score of 3.9/5, possibly because of its thicker texture.

V. CONCLUSION

The comparative evaluation demonstrates that all three formulations provide effective photoprotection and antioxidant benefits, positioning them as viable alternatives to chemical sunscreens. Specifically, F2 is best suited for outdoor or high UV exposure due to its superior SPF and antioxidant profile. F3 is ideal for daily use, particularly for sensitive skin, owing to its light texture, balanced SPF, and high user acceptance. F1 offers a well-rounded profile and serves as a general-purpose herbal sunscreen.

Incorporating aloe vera, watermelon, sandalwood, and turmeric not only contributes to UV protection but also nourishes the skin, making these formulations multifunctional. Further *in vitro* SPF testing and long-term stability studies are recommended to support potential commercialization.

VI. CONFLICTS OF INTEREST: All authors have reviewed and approved the final manuscript and declare they have no conflicts of interest.

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REFERENCES-

1) Sahu, S., Maury, S., Yadav, P., Yadav, M. K., & Sahu, S. (2021). Review literature on sunscreen. *Journal of Emerging Technologies and Innovative Research*, *8*(6), 858-864.
2) Fatima Grace, X., Vijetha, J., Rahul Raj, S., Shanmuganathan, S., & Chamundeeswari, D. (2014). Formulation, *in-vitro* evaluation and UV protective study of polyherbal sunscreen gel. *Google Scholar*.

3) Namdev, V., Yadav, P. K., Gour, R., & Singhai, A. K. Formulation, Development and evaluation of Herbal Skin Care Cream.
4) Korać, R. R., & Khambholja, K. M. (2011). Potential of herbs in skin protection from ultraviolet radiation. *Pharmacognosy reviews*, *5*(10), 164.
5) Bhattacharjee, D., Patil, A. B., & Jain, V. (2021). A comparison of Natural and Synthetic Sunscreen Agents: A Review. *International Journal of Pharmaceutical Research (09752366)*, *13*(1).
6) Mbanga, L., Lenghomo, L., Ngoy, P., Lundemba, A. S., Zuka, M., Ngbolua, K. N., & Mpiana, P. T. (2023). Antioxidant properties of some plants extracts used as natural sunscreen in the formulated cream: Propriétés antioxydantes de quelques extraits de plantes utilisés comme écran solaire naturel dans la crème formulée. *Revue Congolaise des Sciences Humaines et Sociales*, *2*(1), 185-190.
7) Dusi, S. (2020). Formulation and Evaluation of Aloevera and Dacus Carota herbal cream. *International Journal of Pharmacy Research & Technology (IJPRT)*, *10*(1), 31-36.
8) Dhabekar, A. H., Kazi, S. M., & Bais, S. K. A Review: Preparation and Evaluation of Sunscreen.
9) PATEL, S. D. (2024). A review of herbal cosmetics used for skin care and hair care. *Life Sciences Leaflets*, *171*, 1-23.
10) Rasheed, A., Shama, S. N., Mohanalakshmi, S., & Ravichandran, V. (2012). Formulation, characterization, and *in vitro* evaluation of herbal sunscreen lotion. *Oriental pharmacy and experimental medicine*, *12*(4), 241-246.
11) Anusha, V., Moulika, P., Jadhav, S. C., Seshasarvani, N., Kumar, Y. G., & Sushma, K. (2025). Formulation and evaluation of Herbal sunscreen cream encompassed with Tomato, Papaya, Aloe Vera, Sandalwood natural extracts for essential sun protection factor and UV protection. *Asian Journal of Pharmaceutical Research and Development*, *13*(2), 01-11.
12) Rai, A., Thangale, R., Gupta, M. K., & Rai, R. (2024). Formulation and evaluation of Herbal Tenning Lotion. *Bulletin of Pure & Applied Sciences-Zoology*, *43*.
13) Anusha, V., Moulika, P., Jadhav, S. C., Seshasarvani, N., Kumar, Y. G., & Sushma, K. (2025). Formulation and Evaluation of Herbal Sunscreen Cream Encompassed With Tomato, Papaya, Aloe Vera, Sandalwood Natural Extracts for Essential Sun Protection Factor and UV Protection. *Asian Journal of Pharmaceutical Research and Development*, *13*(2), 01-11.
14) Roy, S. (2024). Preparation and Evaluation of Herbal Cosmetic. Recent Trends in Cosmetics (RTC). Recent Trends in Cosmetics. 2024; 1 (2): 26–43p. *Preparation and Evaluation of Herbal Cosmetic Sudipta Roy STM Journals*, 2.
15) Goswami, P. K., Samant, M., & Srivastava, R. (2013). Natural sunscreen agents: A review. *Sch. Acad. J. Pharm*, *2*(6), 458-463.
16) Sharma, M., & Sharma, A. (2023, February). A review on nature-based sunscreen agents. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1110, No. 1, p. 012047). IOP Publishing.
17) Shah, Y., & Mewada, R. (2022). Recent advances in sunscreen agents and their formulations: A review. *International Journal of Pharmaceutical Chemistry and Analysis*, *9*(4), 141-150.
18) Adhe, U. G., Bidait, S. N., & Shere, M. (2025). Formulation and Evaluation of Herbal Sunscreen Cream. *International Journal of Sciences and Innovation Engineering*, *2*(6), 232-

244.

19) Tarantul, A., & Eliseeva, T. (2019). Watermelon (lat. *Citrúllus lanatus*). *Journal of Healthy Nutrition and Dietetics*, *3*(9), 44-56.
20) Meghwar, P., Saeed, S. M. G., Ullah, A., Nikolakakis, E., Panagopoulou, E., Smaoui, S., & Tsoupras, A. (2023). Health Promoting Properties and Applications of Nutrients and Bioactives of Watermelon and Its By-Products.
21) Purwasih, R., & Nasikin, M. A. (2023). Physical quality evaluation and antioxidant activity of Red Watermelon (*Citrullus lanatus* Thunb.) rind extract lotion. *Jurnal Jamu Kusuma*, *3*(2), 81-89.
22) Shrivastava, S., Shrivastava, S., & Tirkey, R. (2025). Fabrication and Efficacy Assessment of a Combination of Polyherbal Facewash Gels for the Treatment of *Propionibacterium acnes*. Recent Advances in Drug Delivery and Formulation.
23) Shrivastava, S., & Daharwal, S. J. (2022). Box–Behnken design avenue for development and validation of high-performance thin-layer chromatography method for estimation of rutin in *Hemidesmus indicus*. Biomedical Chromatography, 36(1), e5236.
24) Gadkari P, Daharwal SJ, Sahu U, Chauhan NS, Singh K, Shrivastava S, Devangan N. Method development and validation for quantification of Yohimbine in root of *Rauwolfia serpentina* by HPTLC. Analytical Chemistry Letters. 2024 Jul 3;14(4):549-60.
25) Daharwal, S. J., & Shrivastava, S. (2019). Preliminary Phytochemical Screening and HPTLC Fingerprinting of Extracts of *Thuja occidentalis*. Research Journal of Pharmacy and Technology, 12(10), 4782-4784.