https://doi.org/10.48047/AFJBS.6.14.2024.3334-3347

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A Research Article On Preparation of Herbal Sunscreen : A Natural Remedy for Skin

Anuj Pathak[*], Amit Pal[1], Shivangi Raghav[2], Ayush Kashyap[3], Shagun Rana[4], Tanu Tyagi[5], Nisha Sharma[6]

[1,2,3,4,5,6] KIET School of Pharmacy, KIET Group of Institutions, Delhi-NCR, Muradnagar, Ghaziabad, 201206, U.P,India

Corresponding Author : Mr. Anuj Pathak
anuj.pathak@kiet.edu

Volume 6, Issue 14, Aug 2024

Received: 09 June 2024

Accepted: 19 July 2024

Published: 11 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.3334-3347

ABSTRACT

Sunscreen lotions are formulated with UV radiations in mind, which come in two main UVB and UVA radiation are the two forms of ultraviolet radiation. These rays from sun can be harmful to the skin, prompting the need for protective measures. Incorporating herbal ingredients into sunscreens offers a natural and effective defense against these harmful rays, taking into account the possible negative effects of synthetic compounds as well as the sun protection factor (SPF). The aim of this study was to create herbal sunscreens with substances like aloe vera, coconut oil, and turmeric, which are known for their protective qualities. Each ingredient serves a specific purpose in shielding the skin from sun damage. Turmeric, for instance, boasts potent antiseptic properties, guarding the skin against bacteria that thrive in perspiration. Meanwhile, coconut oil acts as a natural sunblock agent, providing an additional layer of protection against UV rays. By harnessing the power of these herbal materials, the aim is to create sunscreens that not only offer effective sun protection but also minimize the risk of adverse effects associated with synthetic chemicals. This holistic approach aligns with the growing demand for natural skinscreen product that prioritize both efficacy and safety.

Key words. Sunscreen, Ultaviolet radiation, Natural Sunscreen product.

Introduction

Creating effective sunscreen solutions requires negotiating a challenging terrain where achieving regulatory requirements, guaranteeing efficacy, and appeasing customer preferences are critical. A sunscreen product needs to strike a balance between these elements in order to succeed in the marketplace. A fundamental prerequisite for every sunscreen composition is effectiveness. It entails not just offering

sufficient defense against damaging UV rays but also making sure that the product lives up to expectations in practical aspects like durability and water resistance. As consumers choose products that are soft on their skin and devoid of potentially dangerous substances, safety is another important factor to take into account. Gaining the trust of consumers and establishing the safety profile of sunscreen chemicals requires strict adherence to regulatory regulations and thorough testing[1]. Sunscreen is commonly utilized in order to lower the danger and shield the skin from UV of sun-induced skin ailments. Current research efforts are directed towards the development of broad-spectrum sunscreens, aiming to mitigate the potential long- term consequences associated with excessive UV exposure [2]. UV rays interact with specific bioactive compounds present in the environment, providing a natural shield against their harmful effects on the skin. The increasing popularity of biologically active compounds in cosmetic formulations can be attributed to their safety profile, minimal risk of adverse reactions, absence of harmful chemical constituents, and environmentally friendly characteristics. These factors have spurred a growing preference for cosmetic products that harness the protective properties of natural bioactive compounds, aligning with consumer demand for safer and more sustainable sunscreen products [3]. Natural sunscreens protect the skin from damaging UV rays while also feeding and revitalizing it by utilizing the potency of botanical components. These mixtures frequently contain aloe vera, which is well known for its calming qualities, vitamin E for its antioxidant qualities, turmeric for its ability to reduce inflammation, and cucumber for its moisturizing qualities. When combined, these organic ingredients offer strong defense against UV radiation while also promoting skin renewal and adaptability to external stresses like pollution and weather variations [4-6].

Aloe vera gel is well known for its many advantages in protecting human skin from the damaging effects of sun exposure. It has established itself as a mainstay in traditional medicine for treating a wide range of conditions, including digestive disorders and skin problems like burns, wounds, insect bites, and eczema, thanks to its potent mix of anti-inflammatory, antibacterial, and wound-healing qualities. Studies pertaining to this herbaceous plant seek to verify its traditional uses, explore its modes of action, and pinpoint the precise constituents accountable for its restorative properties. Acemannan, aloe-emodin, aloin, aloesin, and emodin are the active ingredients under investigation. These substances have attracted a lot of research because of their possible roles in the health benefits of the plant. Scientists are working to fully explore the range of medicinal possibilities that aloe vera possesses [7-8]. One member of the Zingiberaceae family of perennial herbaceous plants that produces turmeric is Curcuma Longa. This plant contains curcumin, tannin, and essential oil. The anti-flatulent, anti-inflammatory, anti-fungal, antiparasitic, anti-inflammatory, and anti- cancer effects of curcuma longa extract are remarkable. A 2009 University of Texas survey also shown that Curcuma longa has the benefit of preventing apoptosis [9].

Turmeric's key ingredient, curcumin, is well known for having strong anti-inflammatory and antioxidant qualities. Turmeric has a wide variety of components in addition to curcumin; more than a hundred have been found to date. Turmeric's unique flavor and aroma are mostly attributed to an essential oil called turmerone. Turmeric's bright color is also attributed to its curcuminoids, which are also essential to its therapeutic qualities. As antioxidants, these curcuminoids aid in the body's defense against oxidative stress. Curcumin, demethoxycurcumin, dihydrocurcumin, and 5'-methoxycurcumin are a few important curcuminoids. Curcuminoids reduce oxidative damage and inflammation in the body by scavenging damaging free radicals with their antioxidant activity. Turmeric is a beneficial supplement as its diverse action adds to the possible health advantages linked with its consumption[10-11]. As scientific knowledge and technologies have advanced, so too have the science and formulation of sunscreens, leading to advancements in formulation attributes such as safety, efficacy, and aesthetic appeal. The rise in the

number of skin melanomas has raised worries about sunscreen quality and led to increased requests from the authorities for higher- quality sunscreen products [12]. Maintaining the health of your skin and lowering your chance of developing diseases like sunburn, early aging, and skin cancer depend on preventing sun exposure. To shield the skin from harmful ultraviolet light.

Originating from the Curcuma longa plant, which is a perennial herbaceous plant with rhizomatous roots, turmeric is a member of the Zingiberaceae family. It has tannin, curcumin, and essential oil. Among its many beneficial properties, Curcuma longa extract possesses anti-flatulent, anti-inflammatory, anti-fungal, anti-parasitic, and anti-cancer properties. Furthermore, studies conducted in 2009 at the University of Texas indicate that Curcuma longa might prevent apoptosis. An anti-inflammatory and antioxidant compound found in turmeric is called curcumin. The main components of turmeric are curcuminoids, which give it its color, and turmerone, an essential oil. Turmeric contains antioxidants called curcuminoids, which include curcumin, demethoxycurcumin, dihydrocurcumin, and 5'-methoxycurcumin [13-14].

An essential lipid-soluble antioxidant with photoprotective properties, vitamin E remains necessary towards the wellbeing of people.There is a difference between vitamin E is obtained through pill (all-rac—tocopherol) and from food (RRR—tocopherol). It is recommended to only consume trace amounts of vitamin E that originate from outside sources because photosynthetic activities can produce it [15]. Lauric acid is abundant in coconut oil, which is mostly made from the desiccated kernels of edible coconut palms, or copra. Coconut oil has long been used as a moisturizer; it's especially appreciated for its thick, velvety texture when applied to dry skin. Because of its photoprotective qualities, coconut oil can be included in sunburn formulations to lessen the requirement for inorganic UV radiation components. This can reduce production complexity and satisfy consumer preferences for natural products. Furthermore, new research suggests that coconut oil's high SPF values may be beneficial to people[16].

Sun Protection Factor (SPF) was the primary physicochemical property used to assess the items' efficiency among other biological activities. Curcumin was chosen as a possible bioactive agent because of its phytochemical makeup, which includes a significant amount of polyphenolic compounds. Alpinia galanga is a major component of many commercial sunscreen lotions because it protects skin from UV rays and increases the effectiveness of traditional sunscreens. Some Ideal characteristics of sunscreens are as follows:

a. Sunscreens ideally absorb a wide spectrum of UV rays to effectively shield the skin from sun damage.
b. They should avoid chemical breakdown that could reduce their effectiveness or lead to increased toxicity or irritation due to by-products.
c. Sunscreens should possess compatible properties for formulation with cosmetic bases, ensuring seamless integration.
d. Easy skin penetration is desired for optimal effectiveness.
e. Effective sunscreens should minimize the need for frequent re-application to maintain protection.
f. They should demonstrate efficacy at low concentrations while avoiding irritation or sensitization of the skin .

Material and method-

The botanical garden of the KIET School of Pharmacy in Ghaziabad is where all the herbal ingredients, including lemon (Citrus Limon), turmeric (Curcuma Longa), and aloe vera (Aloe Barbadensis), were gathered. Preservatives, jojoba oil, vitamin E, xanthan gum, shea butter, and coconut oil were gathered from the pharmacy lab of KIET School of Pharmacy. Every single solvent was of analytical quality.

Method

Table 1- Ingredients in herbal sunscreen formulas for Xanthan Gum base

Two bases were used for the preparation of herbal sunscreen formulation.Xanthan Gum base

1) Coconut Oil base

Prepared Sunscreen with Xanthan Gum base -

As seen in (Table 1), various plants were combined with xanthan gum as the base ingredient to generate herbal sunscreen. After soaking two grams of xanthan gum in distilled water, other ingredients like vitamin E, turmeric, and aloe vera were added and well combined for an hour before the preservatives were added. An hour later, evaluation studies were completed.

Table 1- Xanthan Gum base Herbal formulas

Ingredients	**Trial-1**	**Trial-2**	**Trial-3**	**Trial-4**
Xanthane gum	2g	3g	4g	5g
Aloe ver gel	15ml	20ml	25ml	30ml
Coconut oil	2ml	4ml	6ml	10ml
Vitamin E	350mg	350mg	350mg	350mg
Turmeric	300mg	300mg	300mg	300mg
Cetyl alcoh	1.6%	1.6%	1.6%	1.6%
Propyl paraben	0.75%	0.75%	0.75%	0.75%
Purified Water	100ml	100ml	100ml	100ml

Prepared Sunscreen with Coconut Oil

The necessary amount of Shea butter, jojoba oil, and coconut oil was heated for around an hour in a water bath. After the oil phase was reached at room temperature, other components including vitamin E, turmeric, cetyl alcohol and aloe Vera were progressively added while stirring continuously. Until a homogenous and smooth paste was created, this process was repeated. Preservatives were then added to the mixture, as shown in Table 1. After that, the herbal sunscreen was kept cold so that all of the additional analysis and investigation could be completed.

Table -2

Ingredients	**Trial-5**	**Trial-6**
Aloe vera jel	25ml	15ml
Coconut Oil	20ml	12.5ml

Jojoba oil	4ml	3ml
Shea butter	3g	2g
Cetyl Alcohol	1.6%	1.6%
Turmeric	300mg	300mg
Propyl Paraben	0.75%	0.75%

Review-
The review was comes out that thermal stability- stable , phase not separation and SPF value- 33.12 and pH =5.8

Sunscreen Vehicles-

Sunscreen formulations come in various forms worldwide, including gels, lotions, and creams, all of which are emulsion-based products. These formulations, categorized into water in oil (W/O) or oil in water (O/W) emulsions, can influence their absorption and effectiveness. Research comparing sunscreens with the same UV filters but different vehicles showed that while O/W emulsions' efficacy decreased upon water contact, W/O emulsions maintained efficacy due to their water-insoluble emulsifiers and low hydrophilic-lipophilic balance (HLB) values. W/O emulsions also demonstrated the highest Sun Protection Factor (SPF) among the evaluated formulations. Despite this, O/W formulations are preferred by some due to their non-comedogenic properties and lighter feel. The U.S. FDA recommends applying 2 mg/cm2 of sunscreen to achieve desired sun protection, but studies indicate underapplication, with only 25-50% of the recommended amount being applied. To compensate, broad-spectrum sunscreens with SPF 30 or higher are recommended.

According to the American Academy of Dermatology Association guidelines, sunscreen should be applied at least 15 minutes before going outdoors to allow for absorption and effective protection. Reapplication every two hours is advised, especially after sweating or swimming.

While sunscreen helps prevent skin damage, improper removal can have adverse effects. Sunscreen can be removed by washing with water, cleanser, or cleansing oil. Research comparing non-water-resistant and water-resistant sunscreens found that cleansing oil was the most effective for removing water-resistant sunscreen residue, while cleanser was more effective for non-water-resistant sunscreen.

In another study, the water resistance of different sunscreens was tested at various water temperatures, with most products unaffected by temperature changes, except for one that washed off at high temperatures. Additionally, the appearance after sunscreen application is important to consumers, with inorganic filters often leaving a whitish appearance on the skin, which may not be desirable.

Evaluation of formulation

The evaluation of herbal sunscreen formulation involved several keyparameters:

Physical parameter

This encompassed assessing appearance, color, and homogeneity.

Viscosity Determination

Utilizing a Brookfield viscometer, viscosity was measured at various speeds (5, 10, 20, 50, and 100 rpm) to ensure consistency. After the spindle groove was dipped, 50 g of preparation was placed in a beaker with a volume of 50 ml. Screening was then conducted at different speeds, and the results were calculated.

PH Measurment

A digital pH meter was used to measure the sun protection' pH level. After dissolving a specific amount in distilled water, aiming for compatibility with skin pH after 24 hours of use.

Extrudability Study

This involved calculating the percentage of formulation extruded from a collapsible tube within a specific time frame, indicating ease of application [21].

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

Spreadability Assessment

By measuring the time it took for a specified weight to slide off between two slides, the spreadability of the sunscreen was evaluated.
S = M*L/t,
where M is the weight fastened to the upper slide
L is the glass slide's length.
T = amount of time needed to split the slide

Testing for Theramal Durability

Ability of the sunscreen to resist oil separation under specific conditions of humidity and temperature was examined[21].

SPF Determination

Using a UV Visible spectrophotometer, the efficacy of the sunscreens in protecting against UV radiation was measured [22-23].

$$SPF = CF\Sigma_{290}^{320}(\lambda) * I(\lambda) * A(\lambda)$$

Whereas, CF= Correction factor

EE= Erythemogenic effect

I= Intensity of solar light of wavelength

A= Absorbance

Antioxidant Activity Determination

Through the DPPH method, the antioxidant activity of the sunscreens was assessed [24].

$$\%\text{Anti-radical activity} = \frac{\text{Control absorbance} - \text{Sample absorbance}}{\text{Control absorbance}} * 100$$

In- vitro Occlusion Study

The ability of the sunscreen to cover and protect the skin surface was evaluated using a water loss measurement method [25].

Occlusion factor (F) = (A-B)/A * 100

where A= water loss without sample and B = water loss with the sample.

Stability Testing

Centrifugation and freeze-thaw methods were employed to test the stability of the formulations under various conditions [26].

Safety Evaluation by Mutagenicity Assay

Using Salmonella typhimurium strain TA 100, the mutagenic potential of the sunscreen compounds was assessed.
Each aspect of evaluation contributed to ensuring the effectiveness, safety, and quality of the herbal sunscreen formulations [26-28].

In- vitro Occlusion Study

The ability of the sunscreen to cover and protect the skin surface was evaluated using a water loss measurement method [25].

Occlusion factor (F) = (A-B)/A * 100

where A= water loss without sample and B = water loss with the sample.

Stability Testing

Centrifugation and freeze-thaw methods were employed to test the stability of the formulations under various conditions [26].

Safety Evaluation by Mutagenicity Assay

Using Salmonella typhimurium strain TA 100, the mutagenic potential of the sunscreen compounds was assessed.
Each aspect of evaluation contributed to ensuring the effectiveness, safety, and quality of the herbal sunscreen formulations [26-28].

Qualitative tests were conducted to determine the presence of alkaloids, phenols, flavonoids, and tannins in the test extracts.

1) To Assess Alkaloids

- Dragendorff's test involved treating 2 mL of the sample solution with 3 drops of Dragendorff's reagent, leading to the formation of an orange-red/brown precipitate if alkaloids were present.
- Hagers' test consisted of adding three drops of picric acid saturated solution to a two millilitre solution of the sample with the formation of a white-yellow deposit that suggests the presence of alkaloids.
- Mayer's experiment involved adding two milliliters of a test mixture and the three drops of potassium mercuric iodide solution with the development of a yellow or creamy deposit that suggests a presence of alkaloids.
- Wagner's experiment involved adding three drops of iodine solution to 2 mL of test solution, observing in the event that a dark or reddish-brown residue forms.

2) In the case of phenol

- The ferric chloride test required adding two milliliters of the sample solution to three drops of 1% FeCl3 solution.with the appearance of an intense greenish-black color indicating the presence of phenolic compounds.
- The lead acetate test involved adding 1 mL of 10% lead acetate solution adding 2 milliliters of extract solution and waiting for a large, white precipitate to form.

3) In the case of flavanoid

- To perform an alkaline solution assessment, by drops add 3 drops of 1 N NaOH solution to 2 mL of obtain solution. Watch for the emergence of an orange-yellow shade that progressively became more intense as more alkaline droplets were added, which could be diminished by adding diluted hydrochloric acid.
- The ammonia test required subjecting a filtering strip that has been infused with the sample solution to ammonia vapor and observing for the appearance of an orange-red or yellow color.
- The Shinoda test involved putting three drops of strong hydrochloric acid into three milliliters of test solution that contains magnesium turnings and observing for the appearance of a pinkish color.

4) For Tannins

- The gelatin assay involved mixing two milliliters of a water-based mixture with two milliliters of the test solution and 1% gelatin and 10% NaCl with the formation of a whitish precipitate or milky color indicating the presence of tannins.

5) Additionally, both extracted and stabilized oils' ultraviolet (UV) rays were determined. using a UV spectrophotometer, with methanolic solutions of the extracts and The stable oils were

produced in isolated hexane solutions, and their absorbances were measured between 290 and 400 nm.

Results and Discussion

Test	PH	Thermal Stability	SPF	Skin Irritation	Centrifugation	Homogeneity	Appearance
F1	6.6±1.2	Unstable	2.30	No	Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow
F2	6.77±2.92	Unstable	7.63	No	Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow
F3	6.83±.90	Unstable	1.52	No	Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow
F4	6.91±.93	Unstable	2.3	No	Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow
F5	5.7	Stable	32.23	No	No Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow
F6	5.6	Stable	33.12	No	No Phase Separation	Uniform & Homogeneous	Cream-colored, Greenish-yellow

There are six formulation F1,F2,F3,F4,F5,F6 Were prepared as per Table 1 contain Xanthan Gum ,Coconut oil, Aloe Vera ,Turmeric, Vitamin, Jojoba oil, Shea butter and Distilled water. The Result of physiological properties such as PH, Thermal Stability, SPF, Skin Irritation, Centrifugation, Homogeneity, color and Thickness are summarized in Table 2.

The Thermal stability for F1,F2,F3 and F4 were not stable and for F5 and F6 was stable . Formulations have a pH between 5.6 to 7.76, which is consistent with skin pH. The SPF value for F1-2.30, F2-7.63, F3-1.52, F4-2.3 were calculated that are present in table but that are not suitable for skin . SPF value for F5-32.23, F6-33.12 was calculated that was satisfying result for skin . No any irritation problem was determined from sunscreen . In F1, F2, F3 and F4 physical

form of formulation were separated and last two formulation F5 and F6 was not Separated . it was homogeneous , uniform very well and Its color was like greenish – yellow .

There were no indications of sensitivity, erythema, or edema in the Wistar albino rats used for the skin irritation test. Formulations According to the results of the mutation trials, F1, F2, F3, F4, F5, and F6 are not carcinogenic. For this reason, the developed formulations were deemed safe. Because dead cells were removed from formulations F5, and F6, it was discovered that the skin glow effect lasted for a long time. It is discovered that the specially made herbal lotion may block UV rays and shield the skin from sunburn.

Table 1 lists the absorbance values (λmax) of both designed and commercial sunscreens at various wavelengths between 290 and 320 nm. The findings indicated that F5 and f6 had a high SPF of 32-33, which could be related to curcumin. The formulations F5 and F6 demonstrated medium SPF, which is adequate to prevent sunburn for almost three hours (sunscreens with SPF ranging from 32 to 33 are termed good protection sunscreens). The formulations' ability to protect against UV solar radiation is made possible by the presence of photoshielding flavanoids like curcumin, which suppress the skin's formation of free radicals. The SPF of herbal sunscreen formulations determined using the in-vitro approach is extremely suited and dependable, as demonstrated by comparison with commercial sunscreens.

Conclusion

Using extracts of coconut oil, Curcuma longa, and aloe vera, the study tried to create a herbal sunscreen cream and tested how effective it was at preventing sunburn. The content of the formulations to get them ready, we altered F1, F2, F3, F4, F5, and F6 and their physicochemical characteristics and SPF were assessed. According to the study, formulation F5 and F6 containing curcumin and coconut oil was shown to be more stable and had a higher SPF value, making it a superior sunscreen cream. They can be used to prevent sunburns on those with regular skin. Furthermore, the formulations were demonstrated to be non-mutagenic, which distinguishes them from synthetic sunscreens. In conclusion, the new research could result in better ways to treat sunburns brought on by exposure to UV light. Additionally, the study demonstrates that UV Spectroscopy is a rapid, precise, and dependable method of evaluating herbal sunscreens' efficacy.

Thus, the results of this study can assist manufacturers, academic institutions, and government agencies in developing global guidelines for herbal sunscreens.

Reference

1) Hanay C, Osterwalder U. Challenges in Formulating Sunscreen Products. Curr Probl Dermatol. 2021;55:93-111. doi:10.1159/000517655
2) Supriya S. Design and Evaluation of Polyherbal Formulation for Treatment of Malaria. Int J Pharm Phytopharmacol Res. 2021;11(3):1-5. doi:10.51847/RY4UUoZG8x
3) Mishra A, Mishra A, Chattopadhyay P. Herbal Cosmeceuticals for Photoprotection from Ultraviolet B Radiation: A Review. Trop J Pharm Res. 2011;10(3):351.
4) Shanbhag S, Nayak A, Narayan R, Nayak UY. Anti-aging and Sunscreens: Paradigm Shift in Cosmetics. Adv Pharm Bull. 2019;9(3):348-59. doi:10.15171/apb.2019.042
    a. Dutta D, Goyal N, Kumar Sharma D. Formulation and development of herbal microsponge sunscreen gel. J Cosmet Dermatol. 2022;21(4):1675-87.
    b. Sajjad A, Subhani Sajjad S. Aloe vera: An Ancient Herb for Modern Dentistry—A Literature Review. J Dent Surg. 2014;2014:1-6.
5) Kryczyk-Poprawa A, Kwiecień A, Opoka W. Photostability of Topical Agents Applied to the Skin: A Review. Pharmaceutics. 2019;12(1):10. doi:10.3390/pharmaceutics12010010

6) Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. Molecules. 2020;25(6):1324. doi:10.3390/molecules25061324.
    a. Shahrzad K, Seyyed MJM, Meisam A, Esmaeil K, Nasrin MA, Hossein M. The effect of Curcuma longa Rhizome Extract on Blood Cells of Mice: An Animal Trial. Pharmacophore. 2017;8(3):19-23.
7) Ruby AJ, Kuttan G, Babu KD, Rajasekharan KN, Kuttan R. Anti-tumour and antioxidant activity of natural curcuminoids. Cancer Lett. 1995;94(1):79-83.
    a. Selvam R, Subramanian L, Gayathri R, Angayarkanni N. The anti-oxidant activity of turmeric (Curcuma longa). J Ethnopharmacol. 1995;47(2):59-67.
8) Jansen R., Osterwalder U., Wang S.Q., Burnett M., Lim H.W. Photoprotection: sunscreen development, efficacy, and controversies. *J. Am. Acad. Dermatol.* 2013;69 867.e1- 867.e14.
9) Ruby AJ, Kuttan G, Babu KD, Rajasekharan KN, Kuttan R. Anti-tumour and antioxidant activity of natural curcuminoids. Cancer Lett. 1995;94(1):79-83.
10) Selvam R, Subramanian L, Gayathri R, Angayarkanni N. The anti-oxidant activity of turmeric (Curcuma longa). J Ethnopharmacol. 1995;47(2):59-67.
11) Saifee M, Atre M, Toshniwal R. Formulation and In-vitro Evaluation of Ethosomal Gel of Repaglinide for Transdermal Delivery. Int J Pharm Phytopharmacol Res. 2021;11(4):11-7. doi:10.51847/lQKgwgUi1l
12) Herzog B, Sohn M. The Formula for Best Sunscreen Performance: Beer-Lambert's Law Under the Microscope. Curr Probl Dermatol. 2021;55:133-43. doi:10.1159/000517663
13) SunSmart position statement | Cancer Council, (n.d.). https://www.cancer.org. au/about- us/policy-and-advocacy/position-statements/sunsmart (accessed November 9, 2022).
    a. Vogler BK, Ernst E; Aloe vera: A systematic review of its clinical effectiveness. British Journal of General Practice, 1999; 49(447): 823–828.
    b. West DP, Zhu YF; Evaluation of Aloe vera gel gloves in the treatment of dry skin associatedwith occupational exposure.
    c. Rajpal V; Aloe barbadensis Mill/A. veraTourn ex linn. In Standardization of botanicals testing and extraction methods of medicinal herbs.
    d. Daud FS, Kulkarni SB; Comparative evaluation of photo protective effect of aloe vera Tourn. ex. linn on UV damage in different Asian hair types. Indian Journal of Natural Products and Resources, 2011; : 179-183.
14) Naturalsunscreen Available from http://wakeup- world.com/2012/05/14/naturalsunscreen/
15) Kumar sumit, Swarankar Vivek, Sharma sujata, Baldi Ashish, Herbal cosmetics: Used for Skin and Hair, Inventi Journals(P) Ltd, 10/10/2012
    a. Patel NP, Highton A, Moy RL. Properties of topical sunscreen formulations: A review. The Journal of dermatologic surgery and oncology. 1992;18(4):316-20.
16) Saifee M, Atre M, Toshniwal R. Formulation and In-vitro Evaluation of Ethosomal Gel of Repaglinide for Transdermal Delivery. Int J Pharm Phytopharmacol Res. 2021;11(4):11-7. doi:10.51847/lQKgwgUi1l
17) Shakib Z, Shahraki N, Razavi BM, Hosseinzadeh H. Aloe vera as an herbal medicine in the treatment of metabolic syndrome: A review. Phytother Res. 2019;33(10):2649-60. doi:10.1002/ptr.6465
18) Ahmady A, Amini MH, Zhakfar AM, Babak G, Sediqi MN. Sun Protective Potential and Physical Stability of Herbal Sunscreen Developed from Afghan Medicinal Plants. Turk J Pharm Sci. 2020;17(3):285-92. doi:10.4274/tjps.galenos.2019.15428
19) Klimek-Szczykutowicz M, Szopa A, Ekiert H. Citrus limon (Lemon) Phenomenon-A Review of the Chemistry, Pharmacological Properties, Applications in the Modern Pharmaceutical, Food, and Cosmetics Industries, and Biotechnological Studies. Plants (Basel). 2020;9(1):119.

20) Goetz P. Citrus limon (L.) Burm. f. (Rutacées) citronnier. Phytothérapie. 2014;12(2):116- 21.
21) Bouwstra JA, Gooris GS, Dubbelaar FE, Ponec M. Cholesterol sulfate and calcium affect stratum corneum lipid organization over a wide temperature range. J Lipid Res. 1999;40(12):2303-12.
22) Hachem JP, Crumrine D, Fluhr J, Brown BE, Feingold KR, Elias PM. pH directly regulates epidermal permeability barrier homeostasis and stratum corneum integrity/cohesion. J Invest Dermatol. 2003;121(2):345-53.
23) Behne MJ, Meyer JW, Hanson KM, Barry NP, Murata S, Crumrine D, et al. NHE1 regulates the stratum corneum permeability barrier homeostasis. Microenvironment acidification assessed with fluorescence lifetime imaging. J Biol Chem. 2002;277(49):47399-406.
24) Robbins RJ (2003) Phenolic acids in foods: An overview of analytical methodology. J Agric Food Chem 31:2866–87
    a. Rolim A, Oishi T, Maciel CPM, Zague V, Pinto CASO, Kaneko TM, Consiglieri VO, Velasco MVR (2006) Total flavonoids quantification from O/W emulsion with extract of Brazilian plants. Int J Pharm 308:107–114

25) Sagarin E (1957) Cosmetics, Science, and Technology. Interscience Publishers, Inc, New York, p 1014
26) Santo EP, Freitas ZM, Souza KR, Garcia S (1999) In vitro and in vivo determinations of sun protection factors of sunscreen lotions with octyl methoxycinnamate. Int J Cos Sci 21:1–5
27) Sayre MR, Stanfield J, Lott DL, Dowdy JC (2003) Simplified method to substantiate SPF labelling for sunscreen products. Photodermatol Photoimmunol Photomed 19:254–260
28) Sayre RM (1993) Correlation of in vivo tests, in vitro SPF predictions - a survey of published studies. Cosmetics& Toiletries 108:111–114
    a. Shrivastava S, Kapoor S, Saraf S (2003) Novel preparation and evaluation of lotion containing aloe gel beads. Ind J Pharm Edu Res 42(2):77–80
29) Tabrizi H, Mortazavi SA, Kamalinejad M (2003) An in vitro evaluation of various Rosa damascena flower extracts as natural antisolar agent. Int J Cosmet Sci 25:259–265

30. Velasco MVR, Balogh TS, Pedriali CA, Sarruf FD, Pinto CASO, Kaneko TM, Baby AR (2008) Associac¸ ão da rutina com pmetoxicinamato de octila e benzofenona-3: avaliac¸ ão in vitro da eficácia fotoprotetora por espectrofotometria de refletância. Lat Am J Pharm 27:23–27
31. Lakhdar H, Zouhair K, Khadir K, Essari A, Ricard A, Seite S, Rougier A. Evaluation of the effectiveness of a broad-spectrum sunscreen in the prevention of chloasma in pregnant women. *J Eur Acad Dermatol Venereol.* 2007;21:738–742. [PubMed] [Google Scholar]
32. Wolf R, Tüzün B, Tüzün Y. Sunscreens. *Dermatol Ther.* 2001;14:208–214. [Google Scholar]
33. Imam S, Azhar I, Mahmood ZA. In-vitro evaluation of sun protection factor of a cream formulation prepared from extracts of musa accuminata (L.), psidium gujava (L.) And pyrus communis (L.) *Asian J Pharm Clin Res.* 2015;8:234–237. [Google Scholar]
34. Chanchal D, Swarnlata S. Herbal Photoprotective Formulation and their Evaluation. *Ope Nat Prod J.* 2009;2:71–76. [Google Scholar]
35. Afaq F, Mukhtar H. Botanical Antioxidant in the Prevention of Photocarcinogenesis and Photoaging. *Exp Dermatol.* 2006;15:678–684. [PubMed] [Google Scholar]
36. Gasparro FP. Sunscreen, Skin Photobiology, and skin cancer: The Need for UVA Protection and Evaluation of Efficacy. *Environ Health Perspect.* 2000;108:71–78. [PMC free article] [PubMed] [Google Scholar]
37. Vainio H, Miller AB, Bianchini F. An International Evaluation of the Cancer Preventive Potentioal of Sunscreens. *Int J Cancer.* 2000;88:838–842. [PubMed] [Google Scholar]
38. Afaq F, Mukhtar H. Photochemoprevention by Botaanical Antioxidants. *Skin Pharmacol Appl Skin Physiol.* 2002;15:297–306. [PubMed] [Google Scholar]
39. Chermahini SH, Majid FAA, Sarmadi MR. Casmeceutical Value of herbal extracts as natural ingredient and novel technologies in anti aging. *J Med Plants Res.* 2011;5:3074–3077. [Google Scholar]
40. Psotova J, Svobodova A, Kolarova H, Walterova D. Photoprotective properties of Prunella vulgaris and rosmarinic acid on human keratinocytes. *J Photochem Photobiol B.* 2006;84:167–174. [PubMed] [Google Scholar]
41. Aquino R, Morelli S, Tomaino A, Pellegrino M, Saija A, Grumetto L, Puglia C, Ventura D, Bonina F. Antioxidant and photoprotective activity of a crude extract of Culcitium reflexum H.B.K. leaves and their major flavonoids. *J Ethnopharmacol.* 2002;79:183–191. [PubMed] [Google Scholar]
42. Korac RR, Khambholja KM. Potential of herbs in skin protection from ultraviolet radiation. *Pharmacogn Rev.* 2011;5:164–173. [PMC free article] [PubMed] [Google Scholar]
43. Breckle SW, Rafiqpoor MD. Field Guide Afghanistan: Flora and Vegetation. *Germary: Scientia Bonnensi.* 2010;430. [Google Scholar]
44. Jarzycka A, Lewinska A, Gancarz R, A wilk K. Assessment of extracts of Helichrysum arenarium, Crataegus monogyna, Sambucus nigra in photoprotective UVA and UVB; photostability in cosmetic emulsions. *J Photochem Photobiol B.* 2013;128:50–57. [PubMed] [Google Scholar]
45. Shah B, Seth AK. textbook of pharmacognosy and phytochemistry (1st ed) *Haryana: ElsevieR.* 2010;189:234–236. [Google Scholar]
46. Harborne A. Phytochemical Methods: A guide to modern techniques of plant analysis

(3rd ed) *Springer.* 1998:31–110. [Google Scholar]
47. Banu KS, Cathrine L. General Techniques involved in Phytochemical Analysis. *Int J Adv Res Chem Sci.* 2015;2:25–32. [Google Scholar]
48. Bhandary SK, Kumari NS, Bhat VS, Sharmila KP, Bekal MP. Preliminary phytochemical screening of various extracts of Punica granatum peel, whole fruit and seeds. *NUJHS.* 2012;2:34–38. [Google Scholar]
49. Evans WC. Trease and Evans Pharmacognosy (16th ed) *London; SAUNDERS.* 2009;136:616. [Google Scholar]
50. Tabrizi H, Mortazavi SA, Kamalinejad M. An in vitro evaluation of rosa damascena flower extracts as a natural antisolar agent. *Int J Cosmet Sci.* 2003;25:259–265. [PubMed] [Google Scholar]
51. Oomaha D, Ladet S, Godfrey DV, Liang J Girard B. Characteristics of raspberry (Rubus idaeus L.) seed oil. *Food Chemistry.* 2000;69:187–193. [Google Scholar]
52. Kim SH, Jung EY, Kang DH, Chang UJ, Hong YH, Suh HJ. Physical stability, antioxidative properties, and photoprotective effects of a functionalized formulation containing black garlic extract. *J Photochem Photobiol B.* 2012;117:104–110. [PubMed] [Google Scholar]
53. Salvador A, Chisvert A. Analysis of Cosmetic Product, Amsterdam. *Elsvire.* 2007;94. [Google Scholar]
54. Mansur JDS, Breder MNR, Mansur MCA, Azulay RD. Determinação do fator de proteção solar por espectrofotometria. *An Bras Dermatol.* 1986;61:121–124. [Google Scholar]
55. Santos EP, Freitas ZM, Souza KR, Garcia S, Vergnanini A. In vitro and in vivo determinations of sun protection factors of sunscreen lotions with octylmethoxycinnamate. *Int J Cosmet Sci.* 1999;21:1–5. [PubMed] [Google Scholar]
56. Wolski T, Ludwiczuk A, Baj T, Glowniak K. Genus Panax taxonomy chemical composition pharmacological effects medicinal application and phytochemical analysis of aerial and underground parts of american ginseng (Panax quinquefolium L.). Method of extraction and determination of phenolic compounds. *Postepy Fitoterapii.* 2008;4:206–223. [Google Scholar]
57. Dutra AE, Kedor-Hackmann ERM, Santoro Miritello IRM. Determination of sun protection factor (SPF) of sunscreen by ultraviolet spectrophotometry. *Braz J Pharm Sci.* 2004;40:381–385. [Google Scholar]
58. Ebrahimzadeha MA, Enayatifard R, Khalilia M, Ghaffarloo M, Saeedi M, Charati JY. Correlation between Sun Protection Factor and Antioxidant Activity, Phenol and Flavonoid Contents of some Medicinal Plants. *Iran J Pharm Res.* 2014;13:1041–1047. [PMC free article] [PubMed] [Google Scholar]
59. Baliga MS, Katiyar SK. Chemoprevention of photocarcinogenisis by selected dietary botanicals. *Photochem Photobiol Sci.* 2006;5:245–253. [PubMed] [Google Scholar]
60. Bonina F Lanza M, Montenegro L, Puglisi C, Tomaino A, Trombetta D, Castelli F, Saija A. Flavonoids as potential protective agents against photo-oxidative skin damage. *Int J Pharm.* 1996;145:87–94. [Google Scholar]
61. Beveridge T, Li TSC, Oomah BD, Smith A. Sea Buckthorn Products: Manufacture and Composition. *J Agric Food Chem.* 1999;47:3480–3488. [PubMed] [Google Scholar]
62. Betz G, Aeppli A, Menshutina N, Leuenberger H. In vivo comparison of various liposome

formulations for cosmetic application. *Int J Pharm.* 2005;296:44–54. [PubMed] [Google Scholar]
63. Benson HAE, Watkinson AC. Transdermal and Topical Drug Delivery: Principles and Paractice. *New Jersey: John Wiley & Sons.* 2012;268. [Google Scholar]
64. Wiechers JW, Solutions JW. Formulating at pH 4-5: How Lower pH Benefits the Skin and Formulations. Cosmetics Toileters. 2013. [Google Scholar]