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REVIEW ON: PHOTOPROTECTION FROM UV RADIATION: ROLE OF HERBAL PLANTS

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ABSTRACT

Sun light is the most important requirement for life, but highly sun exposure caused major skin problems like, pigmentation, sunburn, dermatitis, wrinkles & skin cancers. For the protection of harmful rays cloths, glasses are not so much sufficient, so for this reason sunscreen are used to Protect from harmful sunlight's. The expanding frequency of skin diseases and photo damaging impacts brought about by UV radiation has expanded the utilization of sun-screening agents, which have demonstrated advantageous impacts in decreasing the manifestations and reoccurrence of these types of skin issues. Now days sunscreen are used for protection from UV rays. Sunscreens are the substance that protect the skin from UV radiation. Plants & Plant materials, with the capacity to retain or square UV radiation have been widely investigated for improvement as items for securing the skin against unsafe sun radiation. The introduction of skin to UVB radiation destructively affects keratinocytes by causing DNA damage that can in this way lead to threatening change. Cell protection components against this injury start with the quick UVB-prompted demise of damaged cells. Herbs arrangements have a high potential because of their cell reinforcement movement, principally. Cell reinforcements, for example, vitamins (vitamins C, vitamins E), flavonoids, and phenolic acids assume the principle job in battling against free radicals'

species that are the fundamental driver of various negative skin changes. This review highlighted the natural products are used to reduce the harmful effect of UV radiations.

Keywords: *In vitro* SPF, Photoprotective plants, Herbal Sunscreen, Ultraviolet radiations

INTRODUCTION

Sun has played very important character for life. Sunlight based radiation arriving at the earthbound surface involves Ultraviolet light (UV), Visible light & infrared (IR) rays. UV radiations wavelength is between 200-400 nm. A UV radiation is again divided into three ranges i.e., UVA, UVB & UVC. The wavelength of UVA is between (320-400nm) UVB (280-320nm) & UVC (100-280 nm). UV-prompted skin cancer is one of the most widely recognized worries on the planet **[1]**. UVA & UVB rays can prompt skin damage, skin cancer, hyperpigmentation & aging **[2]**. Below 290 nm Wavelengths are consumed by the Atmospheric ozone so that these rays are don't pass the surface of earth **[3]**. For protection of these harmful UV rays, now days photoprotective agents are used very commonly. Sunlight based UV radiations at the earth surface envelop about 95-98 % UVA & 2-5 % UVB. Sunscreen preparations are the formulations which are used to protect the skin from harmful sun rays **[4]**.

UVB radiation isn't totally filtered through by the ozone layer and is liable for the damage because of burn from the sun. Stratum corneum is the outer layer of epidermis, in which UVB radiation is completely absorbed, while up to half of occurrence UVA radiation penetrates the skin deep into the dermis. UVB radiations can likewise advance the arrangement of cyclobutane pyrimidine dimers & photoproducts that prompt mutation in epidermal cells and can prompt abnormal cell development & expanded danger of skin cancer **[5]**. Due to these dangerous reasons the sunscreens are used to protect the skin from the harmful sun rays. Sunscreens formulations may contain Moisturiser, cream, lotion, Skin & Hair preparations etc. Sunscreens are also known as sunblock. Properties of sunscreens are as given in the **Figure 1**.

Classification of sunscreens:

Sunscreens are classified into two types either Topical & Systemic. The topical sunscreens are again classified into two types Organic & Inorganic sunscreens.

Organic Sunscreen: Organic sunscreens are again classified into three categories i.e. UVB (290–320 nm), UVA (320–400 nm) & broad-spectrum sunscreens (290–400 nm) some examples are mention in **Table 1**.

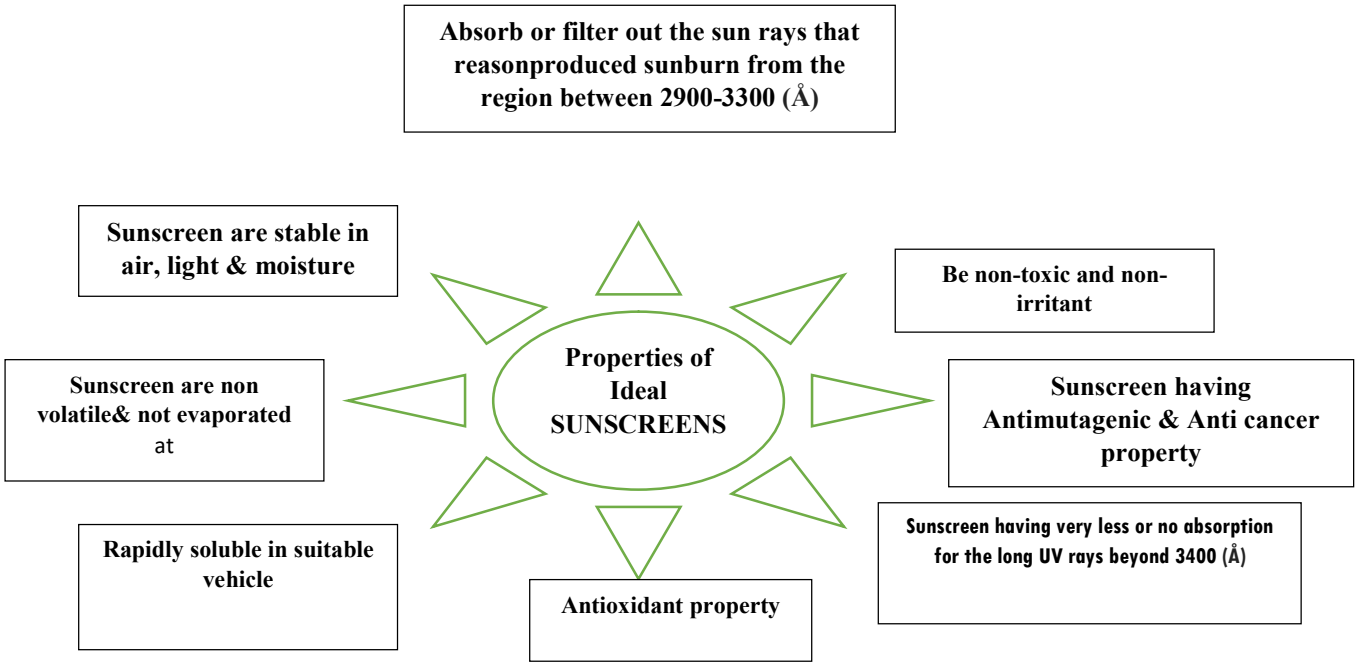

Figure 1: Properties of sunscreens

Table 1: Classification of Organic Sunscreen

UVB(290–320 nm)	UVA(320–400 nm)	Broad spectrum organic filters(290–400 nm)
PABA derivative salicylates including octisalate and homosalate, cinnamates including octinoxate and cinoxate, octocrylate, benzsulidone and dibenzoylmenthanes	benzophenones; oxybenzone and sulisobenzone, avobenzone and meradimate, Methyl anthranilanate and ecamsule.	besoctrizole, silatriazole

Inorganic sunscreens

Inorganic sunscreens are having ability to scatter & reflect UV rays back to the environment. Examples of Inorganic sunscreen are titanium dioxide, zinc oxide, Kaolin, Talc & Calamine.

Systemic sunscreens

Systemic sunscreens that are absorbed into the body and aggregate in the skin managing security from the UV rays. Examples are Ascorbic acid, β-carotene, α-Tocopherol, Aspirin, Indomethacin, Corticosteroid, Selenium, Retinol, Green Tea polyphenol **[6]**.

Herbal plant for sunscreen preparations:

Herbal based cosmetics are more suitable for sensitive skin. In Hyperallergic skin they produced less side effect like they are less irritant & easily adjusted by the skin. Herbal based sunscreen having more antioxidant constituents that's result is produced good photoprotective activity from harmful sun rays **[4]**.

Demand of Herbal Sunscreens because of following points:

- No or less side effect
- Herbal ingredients produced no allergic reactions

- Herbal based cosmetics produce no comedogenic effect
- Renewable resources
- These are more effective and are rich with its stability, safety, purity.
- They are cost effective & inexpensive.
- Herbal preparations having high potential due to their antioxidant activity **[4]**.

Efficacy of a sunscreen:

The efficacy of sunscreens are expressed by the Sun Protection factor. It is determine that Sunscreen provides how much protection when applied to the skin at a thickness of 2 mg/cm^2 it is determined by In vivo & In vitro methods. Higher SPF value is more effective from harmful sun rays **[5]**.

Herbal plants having sunscreen activity, **Table 2** shows some Reported plants having sun screen activity.

Mention **Table 3** shows some reported plants with their In Vitro Sun protective factor [SPF]. **[35-38]**.

Table 2: Reported plants having sun screen activity

Plant/ Common name	Botanical Name with family	Chemical constituents	Reported Sunscreen activity
Amla	*Emblica officinalis* Euphorbiaceae	Amla contain rich amount of ascorbic acid (vitamin c) minerals, amino acids, calcium, iron, carotenes. polyphenols such as phyllembin, flavonoids, kaempferol	The Fruit extract of *Emblica officinalis* was showed photoprotection efficacy. Different types of in Vitro models are used for this investigation. Result showed 1-O-Galloyl-β-D-glucose (β-glucogallin) found in Amla extract showed photoprotection efficacy.[7] Fruit extract of *Phyllanthus emblica* shown its efficacy in protection against ultraviolet-B (UVB) irradiation-induced Reactive Oxygen Species (ROS) & collagen damage in normal human dermal fibroblasts.[8]
Datura	*Datura metel* (Family Solanaceae)	Datura contain Main constituents of the Datura plant are a huge number of tropane alkaloids (hyoscyamine, hyoscine, littorine, acetoxytropine, valtropine, fastusine, fastusinine), a number of withanolides and various trigloyl esters of tropine and pseudotropine Active constituents of Datura tropane alkaloids (hyoscyamine, hyoscine, littorine, acetoxytropine, valtropine, fastusine, fastusinine), withanolides&trigloyl esters of tropine &pseudotropine& Atropine [9]	*D. metel* methanol extract also showed similar SPF activity as like Eucalyptus water extract, i.e.,17.5 at 150µg/ ml. Water & methanol are used for extraction of *Datura metel*, In this study flower and leaf are used of *Daturametel* plant. Water extract of leaf shows SPF value 7.16±1.85 at 150µg/mL & methanolic extract of datura leaf shows 17.50±5.08 at 150µg/mL. In other one flowers of *Datura metel*, water extract shows 5.99±0.59 and methanol extract of flowers shows 7.83±1.54 at 150µg/mL[10]

Eucalyptus	***Eucalyptus globulus*** **(Myrtaceae)**	**1,8-cineole (4.10–50.30%) depending upon maturity and origin of their collection site. Other major components of the leaf oils were α-pinene (0.05–17.85%), p-cymene (trace-27.22%), cryptone (0.00–17.80%) and spathulenol (0.12–17.00%). In contrast, the essential oil of fruit, bud and branch oils is known to contain α-thujene (0.00%, 11.95% and trace respectively), 1,8-cineole (15.31%, 36.95% and 56.96% respectively) and aromadendrene (23.33%, 16.57% and 8.24% respectively). Eucalyptus globulus contain 1,8-cineole ,α-pinene , p-cymene, cryptone and spathulenol. Eucalyptus glabrous oil contain the volatile organic compounds counting hydrocarbons, alcohols, aldehydes, ketones, acids, ethers & esters.[11]**	***Eucalyptus globulus*** **leaf are extracted in water &methanol . SPF Value in water extract found 17.9±4.3 at 150µg/mL. In methanol extract SPF observed 23.5±9.58 at 150µg/mL. Result shows that *Eucalyptus globulus* having good UV absorption.[10]**
Harshringar	***Nyctanthes arbortristis*** **family Oleaceae**	***Nyctanthes arbortristis*** **consist of nyctanthine, mannitol, resinous substances, astringent principles, ascorbic acid nyctanthin, traces of an oilysubstancecoloring matte rs, sugar & tannic acid, carotene, methyl salicylate, volatile oil. linoleic, lignoceric oleic, stearic, palmitic acid and β-sitosterol.[12]**	**Flower of *Nyctanthesarbortristis* extracted with ethanol & Petroleum ether and further formulated cream. sunscreen cream containing ethanolic extract *Nyctanthesarbortristis* shows higher SPF 10.21±2.18.[13]**
Phaleriamacrocarpa	***Phaleria macrocarpa*** **family Thymelaceae**	**It contain benzophenones, lignans, sesquiterpenes, triterpenoids & xanthones, kaempferol, myricetin, naringin, gallic acid, rutin, quercitin[14]**	**In this study *Phaleriamacrocarpa*fruits are used and isolated mahkoside A, mangiferin&6,4-dihydroxy-4-methoxybenzophenone-2-O-β-Dglucopyranoside, At 100 ppm concentration SPF of mahkoside A, mangiferin and 6, 4-dihydroxy-4-methoxybenzophenone-2-O-β-Dglucopyranoside was found that 3.44, 2.82 and 3.08. In-vivo test results demonstrated that mangiferin at concentration of 12.5%, 25%, & 50% diminished the amount of erythema & erythema diameter across fundamentally unique in relation to negative control . This study shows that*Phaleriamacrocarpa*fruits having sunscreen action in-vitro and in-vivo.[15]**
Marigold	***Calendula officinalis*** **L., Family: Asteraceae)**	***Calendula officinalis*** **flower consist of flavonoids, quinones, coumarines, carotenoids, volatile oil, & amino acids.carbohydrates, phenolic compounds, lipids, steroids, tocopherols, terpenoids, quinones and carotenoid.[16]**	**Oil was isolated out by Clavenger's apparatus, cream prepared by homogenization method and evaluate by physical parameter. SPF determine by specrtophotometry method of Calendula flower oil cream. Calendula oil in cream formulation shows good SPF activity (14.84 ± 0.16). This investigation recommended that calendula oil cream can be utilized to prevent the skin from UV radiations in type of sunscreen cream and to keep up the characteristic pigmentation of the skin.[17]**

Green tea	***Camellia sinensis* (L.) Family: (Theaceae)**	***Camellia sinensis* alkaloids (caffeine, theophylline and theobromine) contain Catechins, epicatechin gallate (ECG), (-)-epicatechin (EC) epigallocatechin (EGC) and (-)-epigallocatechin gallate, Flavonols , Other flavonoids, Ascorbic acid, Theogallin 1-2 , Gallic acid , Theanine, Methylxanthines[18]**	***Alcoholic extract of Camellia sinensis* leaves extract are used SPF determine by using UV spectrophotometric method. SPF was found to be 18,10±0.05, The result shows that *Camellia sinensis* was having a good Photo-chemo protective activity.[19]**
Indian Madder	***Rubia cordifolia* Linn belonging to family Rubiaceae**	**Active constituents of *Rubia cordifolia* anthraquinones,naphthoic acid esters, ,bicyclic hexapeptides, and triterpenes.[20]**	***Rubiacordifolia* shows helpful impacts in treating skin conditions like pigmentation, hyper pigmentation, allergies, eczema & sunburn [21]**
Caroa	***Neoglaziovia variegata* Family (Bromeliaceae)**	**It contain steroids, terpenoids & phenolic compounds & flavonoids.[22]**	**SPF of hydroalcoholic extract of *Neoglazioviavariegata* 5.43±0.07&11.73±0.04 atconcentrations of 0.5 and 1.0% (v/v). And compared with the SPF of Quercetin (2.45 ±0.13) and benzophenone-3 (5.10 ± 0.15). Result shows that hydroalcoholic extract of *Neoglazioviavariegata* having good SPF value.[23]**
Banafsha	***Viola odorata* *Family: (Violaceae)***	**It contain alkaloid, saponin, glycoside, mucilage, methyl salicylate, Vitamine c [24]**	**In This study In vitro SPF of Ethanolic extract of *Viola odorata* were estimated. For standard Marketed formulation is used having SPF 50. SPF OF ethanolic extract of *Viola odorata* was found to be at concentration 100 µg/ml & 200 µg/ml 4.05±0.07 and 11.66±0.04, *Viola odorata* Gel formulations (F1-F3) SPF estimated 2.89±0.01, 4.20±0.08, and 5.63±0.07, respectively. Result shows that *Viola odorata* ethanolic extract and the formulated gels having sun protective activity.[25]**
Ceylon slitwort	***Leucas zeylanica,* family Lamiaceae**	***Active constituents of Leucas zeylanica are* alkaloids, glycosides, amino acids, flavonoids, steroid.[26]**	**SPF of *Leucas zeylanica,* determine by the UV spectrophotometer method . Study showed that *Leucas zeylanica,* having SPF 39.8 ± 0.35 that shows that high UV absorption properties.[27]**
Jamaica flowers	***Hibiscus sabdariffa* Malvaceae**	***Hibiscus sabdariffa* Contain polyphenols especially anthocyanins, polysaccharides & organic acids.[28]**	**In vitro SPF activity of *Hibiscus sabdariffa* perform by using extract in solvent i.e. ethanol, ethyl acetate & hexane by using UV-Vis . The outcomes uncovered that the of Ethanol & ethyl acetate extract of *Hibiscus sabdariffa* showed characteristic absorption bands in the UVA & UVB regions, and the hexane extract was observed to absorb in the UVB and UVC. *Hibiscus sabdariffa* ethanol extract showed highest SPF 17.53±0.22 . [29]**
Moldavian balm/ Moldavian dragonhead	***Dracocephalum moldavica* Lamiaceae**	**linolenic and linoleic acids, fatty oil[30]**	**The ethyl acetate extract of of leaves of *Dracocephalummoldavica* L observed SPF 24.79. Result shows that *Dracocephalummoldavica* having good SPF activity.[31]**
Wild pansy	***Viola tricolor* L. (Violaceae)**	***Viola tricolor* L. contains salicylic acid & its derivatives methyl ester &violutoside phenolcarboxylic acids such as trans-caffeic acid, protocatechuic acid, p-coumaric acid; mucilages, tannins, rutin, violaquercitrin, violanthin, scoparin, saponaretin, orientin, vicenin,**	**The ethyl acetate extract of of flowering tops of *Viola tricolor*found SPF value 25.69. study revealed that *Viola tricolor*contain sun protective activity. [31]**

		anthocyanidin glycosides, carotenoids (saponins; ascorbic acid & tocopherol [32]	
Karanja	*Pongamia pinnata* Fabaceae	*Pongamia pinnata* Contain alkaloids, glycosides, flavonoids, fixed oils, and carbohydrates.[33]	As Aqueous and methanol extracts were seen as incredibly great absorbents of the UV rays in the UVB & UVC regions & the acetone extract was seen as exceptionally viable in UVA region, Study revealed that the leaves of *Pongamiapinnata* contain photoabsorptive Component.[34]

Table 3: Reported plants with their In Vitro Sun protective factor [SPF]

Carica Papaya	16.047±0.05
Promegranate	26.79235
Beet	20.99042
Aloevera	13.29438
Ginger	61.59327
Tomato	17.67403
Kiwi	17.07111
Orange	22.85731
Broccoli	66.61312
Mango	77.68968
Honey	83.99355
Flax seed	132.8994
Mulberry	203.0366
Mentha piperita	8.184 ±0.004
Azadirachtaindica	4.368 ± 0.004
Oscimum sanctum	2.904 ± 0.007
Lycopersicon esculantum	6.083 ± 0.009
Ginkgo biloba	7.06 ± 0.2
Dimorphandramollis	4.96 ± 0.2
Rutagraveolens l	5.34 ± 0.1
Vitisvinifera	3.17 ± 0.2
Beet root,	39.48
Drumstick,	17.48
Green pea,	17.92
Potato,	4.35
Brinjal,	4.31
Sweet potato	12.23

Future prospective of Herbal sunscreens: **[39-42]**

The use of Sunscreen are more beneficial for skin, it is used to reduced the skin disorders which are caused by UV rays. Now days it is more common to used sunscreens for provide skin safety and minimize the photo damaging. Harmful effect by the chemicals on skin, herbal preparation are used to provide safer effect on skin. Now Herbal sunscreen are frequently replacing the organic sunscreen. Many herbal sunscreens formulations are available in market in various forms like Cream, Moisturiser, Gel & Lotion with their labeled SPF value. Herbal sunscreens are more effective due to their No or less side effect**,** Herbal ingredients produced no allergic reactions, herbal based cosmetics produce no comedogenic effect, Renewable resources, these are more effective and are rich with its stability, safety, purity, they are cost effective & inexpensive, herbal preparations having high potential due to their antioxidant activity. Natural compounds contain various constituents like flavonoids, polyphenols, carotenoids, anthocyanins, triterpenoid saponins, due to these active constituents herbal preparations shows good SPF activity. It is necessary to carry out herbal plants for future research to determine the photoprotective efficacy of plants or plants extract so that the effect occur from dangerous UV rays have to be minimized and increase its sun protection factor using different combination of herbal plants.

CONCLUSION

Sunscreens are the agent which provide protection against the harmful UV rays. UV radiation causes skin harm and produce skin cancer, hyperpigmentation & aging. Due to this there are various techniques are used. To avoid sun light directly, but most of the time it is not possible. To avoid the absorption of UV rays to skin various forms of sunscreens are used. The demand of sunscreen mainly consider the point like sunscreen provide Protection to skin from UV radiation, antiaging, reduce wrinkles, provide moisturizing effect & cooling effects on the skin and improve colour of skin also. Regular use of Synthetic sunscreen may cause harmful effect on skin so that natural based formulations are used to avoid these types of skin problems. Plants contain many constituents which protect the skin.

Natural based sunscreens are more helpful as compare to synthetic sunscreens. Plants contain different constituents like Flavonoids, Phenols, anthocyanins, carotenoids these compounds have characteristics for sunscreens and provide photoprotection action. This review is focused on the natural drugs which having sunscreen activity. Combination of these drugs may effective for development of

natural sunscreen by the use of herbal based sunscreen its helpful to reduced the side effect occur by using synthetic sunscreens.

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