Potential of Natural Compounds as Sunscreen Agents

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ABSTRACT
Many skin diseases such as sunburn, pigmentation, wrinkles, dermatitis, urticaria, ageing, skin cancers and immune suppression are due to the extreme exposure to harmful sun radiations. The mere covering of skin through sunglasses, clothes or other external agents is not adequate protection method. Therefore, application of sunscreen is considered as one of the trendiest methods to get rid of the skin aging, sunburn and other related problem arises due to the exposure of ultraviolet radiation (UV) radiations. Sunscreen agents protect from the sun by absorbing the UV and visible sun rays. Herbs have been used in medicines and cosmetics from centuries and their potential to treat different skin diseases, to adorn and improve the skin appearance is well-known. The presented review article is concern with discussion on various plant derived chemicals acting as sunscreen agents such as squalene, peptides, and nucleotides etc and protecting mammalian skin. Herbs and herbal preparations have a high potential due to their antioxidant activity. Antioxidants such as vitamins (Vitamin C, Vitamin E), flavonoids, and phenolic acids play the main role in fighting against free radical species that are the main cause of numerous negative skin changes. Effective botanical antioxidant compounds are widely used in traditional medicine and include tocopherols, flavonoids, phenolic acids, nitrogen containing compounds (indoles, alkaloids, amines, and amino acids), and monoterpenes. Anthocyanin’s, Proanthocyanidin, Quercetin, Anthranilate, Resveratrol, Apigenin, Silimarin, Curcumin, Carotenoids are well known plant derived active chemicals that have potential to absorb radiations. This review covers all essential aspects of potential of herbs as radioprotective agents and its prospects.

Key words: UV radiation, Skin diseases, Skin Cancer, Photoprotection, Phytochemicals, Herbal products, Sunscreen.

INTRODUCTION
Overexposure of sunlight is hazardous to human skin as it has many detrimental effects on eye, immune system as well as on the skin. There has been records of increase in skin cancer related data as a result of various outdoor activities.[1] People heading towards beach in only their bath suit so due to extra exposure of sun sunburn happens experts also says that we can prevent skin cancer by 80% by means of avoiding the sun or by having the protective gear that can prevent sun exposure.[2] As per WHO recommendation, it is essential to put screen of broader spectrum (SPF 15+) in plenty amount after popular outdoor activities like, playing, swimming or exercising.[3,4] The goal of sunscreen formulation is to block UV rays and increase the protection against it.[4] By not using sunscreen when in the sun can accelerate the skin disease like wrinkles, early aging and skin cancer.[5] Approximately one out of five people in United States develop skin cancer in their lifetime. The major cause of these disease is exposure to UV radiations such as UVA and UVB. UVA rays are responsible for sunburn[6] whereas UVB enter more deeper into tissues that is the main cause of premature aging.[6,7] Physical barrier just scatter, reflect and block the UV radiation by using various accessories such as goggles, hat and full sleeve clothes. On the other hand the chemical sun blockers absorb the harmful radiations and shield the skin.[8] Sunlight is essential for bodily functions like producing Vitamin D and maintaining your mood but too much exposure of sun can also be harmful.[9] As per the drug and cosmetic act 1940 and the rule in 1945 “cosmetic” means any article intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance.[10,11] and includes any article intended for use as a component of cosmetic. A sunscreen contains more than one ingredient some provide protection against UVA while some against UVB[12] Sunscreen are mainly rated and marketed by the sun protection factor (SPF) that measures the fraction of UV radiation, Skin diseases, Skin Cancer, Photoprotection, Phytochemicals, Herbal products, Sunscreen.

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PHOTO-PHOTOPROTECTION

Phytoconstituents are very much popular now a days in cosmetic products as they not only prevent the exposure of harmful endogenous and exogenous agents but also protect from many skin diseases. Overexposure of sunlight can lead to the skin cancer and photoaging, which results in appearance of fine lines, wrinkles, loose of the elasticity of skin and hyperpigmentation mark can appear. Herbal extract can heal and soft the skin and also provide sunscreen effects. We have selected some phytconstituent like resveratrol, quercetin, silymarin and Vitamin C that are not only good for skin conditioning but also considered good for the development of herbal cosmetic formulation that can diminish the probability of skin cancer and photoaging process.

Flavonoids

These are the secondary metabolites found in the plants and have potential of blocking harmful radiation by absorbing the sunlight in the ultraviolet region, also have antioxidant property and they modulate several signalling pathways. The presence of flower pigments is a distinguished feature of flavonoid in most of angiosperm families. However, they are not only found in flowers but are also found in all parts of plant. Flavonols are one of the most important categories of flavonoids which carry ketone group and it is also the foundation for proanthocyanin. It can be categorized in various sections according to the oxidation, the degree of unsaturation and the carbon of the ring C where the ring B is attached. Isoflavones are the flavonoid where ring B is attached at position 3 to the ring C. Neoflavonoids, are linked at to ring B at 4 position of ring C, whereas the compounds where attachment of both the ring occur at 2’4’ position, are classified in various subclasses such as flavones, flavanones, flavanols, catechin and its derivatives based on structural features of ring as shown in Figure 2.

Flavonoids are found in various vegetable, fruit, bark and root of some plants, flower, wine and tea. Flavonoids shows anti-mutagenic, anti-carcinogenic, anti-inflammatory actions. UV absorption spectrum of flavonoids has two maximum peaks of absorption, one between 240nm and 280nm and the other at 300-500nm so, they can be used in formulations to block UVa and UVb radiations. The plant extract of cinnamates and flavonoids is known for its potential to protect early aging caused by various external factors, antioxidant properties, absorption of UV rays, useful in cosmetics and action against the free radicals.

Quercetin is obtained from oak plant, that acts as natural inhibitors of auxin. Quercetin is a flavan which is classified under six subclasses of flavonoid. The standard IUPAC nomenclature of quercetin is 3, 3’, 4’, 5, 7-pentahydroxy-2-phenylchromen-4-one or 3, 4, 5, 7-pentahydroxy flavonone, that indicate the presence of hydroxyl group at various positions of quercetin. It lacks the sugar attachment to aglycone part. Physically, it appears as brilliant citron yellow with needle shape crystal, which is highly soluble in alcohols and lipids, insoluble in cold water and very less soluble in hot water. The rich source of quercetin is apple, brassica, berries, grapes, seeds nuts flower, onion, tomatoes, shallots, tea capers, and many bark and leaves. It helps reduce the effects of free radical damage on skin from UV exposure, flavonoids can also provide a non-negligible level of photoprotection in UV range.

Apigenin is found in various fruit like apple, grapes and cherries, found in various herbs (clove, endive and German chamomile), vegetables (beans, leeks, onion, broccoli, celery, parsley) and beverages (wine and tea). Chemo preventive agents protects UV-induced skin cancer and also retard DNA damage in cell free system. Silymarin extract is obtained from oldest herbal plant S. marianum seeds. Silymarin milk thistle is rich constituent of polyphenols. Silymarin is also used in cosmetic and dermatological preparation for its antioxidant's effects. It also has ability to reduce UVb and chemical induced damage.

Terpenoids

Terpenoids or isoprenoids are diverse compounds that are composed of isoprene units (five carbon compound) that has various basic skeleton and functional groups. The term “terpene” and “terpenoid” are frequently interchanged. Sometimes “terpenoids” are included in “terpene”, and somewhere they are labelled as modified terpene. Leray stated that both of these terms should not be used interchangeably. Terpenes are the chemical constituents that possesses 10-15 carbon and terpenoids are terpenes that are modified by removal of methyl group in place of addition of oxygen to hydrocarbon. Depending upon the number of isoprene units terpenoids are categorised as mono, sesqui, di, tri with 2,3,4, and 6 isoprene unit respectively. Steroids, tocopherols, taxanes, artemisinins, ingenanes and cannabinoids are considered as six main class of terpenoids. Many terpenes have biological activities (against cancer, malaria, viral and bacterial diseases and inflammation). Cinnamate acid and its derivatives are found in plant-based food like, whole grains, vegetable and fruit. 3-phenylprop-2-enonic acid or tizaparin or 3-phenylacrylic acid are the called as cinnamic acid. Other derivatives of this class are of cinnamyl alcohol, cinnamaldehyde and dihydrocinnamyl alcohol. Its derivatives in cosmetic in UV protection. Provide protection against UV light ranging from minimum photoprotection. It decreases undesirable effects of sunscreen of this class. Xanthin is found in big concentration in several green leaf vegetable, such as broccoli, spinach kale, cabbage and green mustard leaves etc. Zeaxanthin fraction

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### Major plants phytoconstituents with sun screening potential.

| Plant Name                  | Plant Parts | Major Constituents                                      | Mode of Action                                                                                                                                                                                                                                                                                                                                 | References |
|-----------------------------|-------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| **Flavonoids**              |             |                                                        |                                                                                                                                                                                                                                                                                                                                          |------------|
| Black carrot (Daucus carota)| Root        | Anthocyanins-cyanidin, peonidin, pelargonidin.         | Anthocyanins is the antioxidant activities and fortification against DNA injury, these composites being capable to detain hazardous free radicals as singlet oxygen (1O₂), superoxide radical (O₂⁻), hydroxyl radical (OH) and hydrogen peroxide (H₂O₂), chemical groups that direct to lipid peroxidation of cell membranes. | [63]       |
| Marigold (Calendula officinalis) | Flowers     | Apigenin                                               | Apigenin effective in the prevention of UVA/UVB-induced skin carcinogenesis.                                                                                                                                                                                                                                                               | [64]       |
| Cumin (Cuminum cyminum)     | Fruit       |                                                        |                                                                                                                                                                                                                                                                                                                                          | [23]       |
| Peppermint (Mentha piperita) | Herbs       |                                                        |                                                                                                                                                                                                                                                                                                                                          | [64]       |
| Green and black tea (Camellia sinensis) | Leaves extract | (−)-epigallocatechin-3-gallate (EGCG), (−)-epigallocatechin (EGC), (−)-epicatechin-3-gallate (EGC), and (−)-epicatechin (EC), catechins | 1. Topical green tea applied to human skin provide a photoprotective effect, reduced the number of sunburns cells, protecting epidermal Langerhans cells from UV damage, and reduced the DNA damage that formed after UV radiation. 2. Black tea to the skin to soothe sunburn 3. Catechins help prevent and repair skin damage and may even help prevent chemical- and radiation- induced skin cancers. | [65]       |
| Grape seed (Vitis vinifera) | Seed extract | Oligomeric proanthocyanidins, Catechin, epicatechin, and taxifolin | 1. Grape seed extract in the selected sunscreen lotion resulted in increasing SPF value and had good antioxidant activity. 2. Polyphenols that prevent the generation of reactive oxygen species which suggests an anti-aging action. | [67]       |
| Apple barriers (Malus domestica) | Fruit extract | Quercetin                                              | 1. Help reduce the effects of free radical damage on cells from UV exposure. 2. Flavonoids also provided a non-negligible level of photoprotection in the UVA range                                                                                                                                                                                   | [69]       |
| Milk thistle (Silybum marianum) | Seed        | Silymarin - flavonoid compound                          | 1. Silymarin can provide substantial protection against different stages of UVB-induced carcinogenesis, possibly via its strong antioxidant properties. 2. Silymarin reduced UV-induced sunburn cell formation and apoptosis. 3. Silymarin treatment prevents UVB-induced immune suppression and oxidative stress in vivo | [70]       |
| **Terpenoids**              |             |                                                        | All the camphor-derived sunscreens dissipate the photon energy by cis-trans isomerization. However, for Enfacement the quantum yield for this isomerization is only between 0.13-0.3. This low quantum yield means that other photochemical processes are also occurring | [72]       |
| Camphor (Cinnamomum camphor) | Wood and bark | Enzacamene - 3-Benzylidene camphor - Benzylidene camphor sulfinic acid Camphor benzalkonium methosulfate - 4-Methylbenzylidene camphor - Poly Acryl amido Methyl Benzylidene camphor |                                                                                                                                                                                                                                                                                                                                          | [72]       |
| Plant/Extraction Source | Plant Part | Chemical Constituents/Active Components | Pharmacological Properties |
|-------------------------|------------|----------------------------------------|---------------------------|
| Green, red and yellow plant | Fruit | Zeaxanthin, Canthaxanthin and b-carotene, isoprenoids, lycopene β-carotene, α-tocopherol, and selenium. | 1. The crude extract and the zeaxanthin fraction were incorporated in a gel based sun protective formulation and analysed for the SPF and boot star rating. 2. Oral administration of lycopene β-carotene, α-tocopherol, and selenium reported decreased UV-induced erythema, lipid peroxidation, and sunburn cell formation. |
| Tabat barito (Ficus deltoid Jack) | Leaves | Germanicol cinnamate, glyceryl esters of p-methoxycinnamic acid, 1,3-dipalmityl-2-p-methoxycinnamoyl-1,2,3-propanetriol and 1,3-dioctanoyl-2-p-methoxyxycinnamoyl-1,2,3-propanetriol | 1. Provided protection against UV light, ranging from a minimum protection to ultra. 2. Increase substantivity and decrease eventual undesirable effects of sunscreens of this class |
| Krameria triandra (Krameria lappacea) | Root extract | Octyl methoxycinnamate, 15% neolignans | 1. It absorbs slightly more UV light in the 340-380nm range than the organic sunscreen does 2. As topical antioxidants/radical scavengers against skin photodamage. 3. Antioxidant, photoprotective, cytoprotective effect, radical scavenger |
| White Willow Bark And Wintergreen Leaves | Bark and leaves | Homomenthyl salicylate (homosalate), ethylhexyl salicylate (octyl salicylate) and triolamine salicylate, sorpylbenzyl salicylate, triethanolamine salicylate Salicylic acid salts (potassium, sodium and triethanolamine). | 1. They have weak UVB absorbing properties and are generally used in combination with other chemical absorbing sunscreen agents. 2. Octyl salicylate, are also used to help other UV filters mix into the sunscreen. |
| Tea tree (Melaleuca alternifolia) oil | Leaves | Terpinen-4-ol, 1,8-cineole, alpha-terpineol, and gamma-terpinen. | It is an effective antiseptic, fungicide, and germicide. It is a popular component of many sunscreen formulations that relieve sunburn by increasing blood flow in capillaries, bringing nutrients to damaging skin |
| Walnut (Juglans regia) fresh green shells | | Juglone (5-hydroxy-1,4-naphthoquinone), lawson (2-hydroxy-1,4-naphthoquinone), seven phenolic compound identified in walnut husk - ferulic acid, vanillic acid, coumaric acid, syringic acid, myricetin, and juglone. | 1. Aqueous extract has been shown to be particularly effective as a self-tanning sunscreen agent. 2. Juglone- UV protection properties. 3. Myricetin with antioxidant properties. |
| Almond (Prunus dulcis) | Fruit | Phenolic acid | The UVB protective property of this plant’s skin extract was tested. |

**Antioxidants**

| Plant/Extraction Source | Plant Part | Chemical Constituents/Active Components | Pharmacological Properties |
|-------------------------|------------|----------------------------------------|---------------------------|
| Amla (Emblica officinalis) | Fruit extract | 1-O-Galloyl-β-D-glucose (β-glucogallin), β-Glucogallin | 1. Photoprotection efficacy due to its inhibitory effect on ultraviolet radiation. 2. β-glucogallin can be the active principle which is significantly responsible for the photoprotection efficacy. 3. Strong antioxidant activities against the UV penetration and anti-aging. |
| Plant                        | Part(s)               | Phytochemical(s)                  | Description and References |
|-----------------------------|-----------------------|-----------------------------------|-----------------------------|
| Lemon (Citrus limon)        | Fruits and seed extract | Ascorbic acid (Vitamin C)         | Vitamin C is capable of additive protection against acute UVB damage (sunburn cell formation) when combined with a UVB sunscreen. [80] |
| Orange (Citrus sinensis)    |                       |                                   |                             |
| Mango (Mangifera indica)    |                       |                                   |                             |
| Red grapes (Vitis vinifera) | Grape skins           | Resveratrol stilbene (3,5,4′-trihydroxystilbene) polyphenolic phytoalexin | 1. Effects of resveratrol against ultraviolet radiation mediated oxidative stress and cutaneous damages including skin cancer [81] 2. Topical application with resveratrol (both pre- and post-treatment) results in inhibition of UVB-induced tumor incidence and delay in the onset of skin tumorigenesis. [25] |
| Broccoli Cantaloupe Squash  | Fruit, Rhizomes and Leaf | Retinol (vitamin A) and palmitic acid | 1. It can serve as an antioxidant to improve product performance against the aging effects of UV exposure or to enhance the aesthetic qualities of sunscreen. [83] [84] [85] |
| Triticum vulgare (wheat germ) | Seed, flower, fruit | (α-tocopherol), tocotrienol, linoleic acid | 1. Alpha-tocopherol and tocotrienol—effectively reduce skin roughness, the length of facial lines, and the depth of wrinkles. [86] 2. Vitamin E is a free radical scavenger and an emollient too. [23] 3. Tocopherols and phenolics, which account for 59% of the antioxidant effects. [87] [88] |
| Sesamum indicum (sesame) oils |                       |                                   |                             |
| Cucurbita pepo (pumpkin) seed oil. | Fruit extract | Lycopene | Lycopene scavenges lipid radicals, reduces lipid peroxidation, and prevents erythema caused by UV radiation on the skin. Lycopene may reduce the damaging effect which UV light can have on the skin and can boost protection against both the short term (sunburn) and cumulative effects of sun exposure (cancer) [89-91] |
| Tomato (Solanum lycopersicum) | Fruit extract | Lycopene | Applying sunscreen treatments to pomegranate fruit on the degree of sunburn damage and the effect of maturity and sunburn on the internal antioxidant concentration of the juice. [92,93] |
| Pomegranate (Punica granatum) | Fruits | Ellagitannins and anthocyanins. |                             |
| Cucumber (Cucumis sativus)  | fruits                | ascorbic acid (vitamin C) and caffeic acid, | It also helps remove dead skin cells and tightens skin. Cucumbers soothe skin irritations, prevent water retention and are rich in water, fiber and beneficial minerals. [94,95] |
| Indian Beech Tree           | Leaves extract        | antioxidants                      | The absorption spectra of various solvent extracts of this plant were measured using UV visible Spectrophotomete. The aqueous and methanol extracts were found to be highly effective in UVB region and moderately effective in UVA region. [96] |
| African tulip tree (Spathodea campanulata) | bark | antioxidants | The ability of extract to absorb UV radiation and hence proved its UV protection ability. This plant makes it as a better and safe alternative to harmful chemical sunscreens. [97] |
| **Amino acids** | **Leaves** | **AMINO ACID-Leucine, Isoleucine, Lysine, Methionine, Phenylalanin, Threonine, Valin, Tryptophan. ANTHRAQUINONES-Chrysophanoic Acid, Emodine. ENZYME-Catalase.** | Aloe Vera is a unique and effective moisturizer, and work as a healing agent for the skin. [98] [23] |
| --- | --- | --- | --- |
| **Caprylhydroxamic acid** | **Liquid** | **Caprylhydroxamic Acid or Octano-hydroxamic Acid** | 1. It’s a gentle preservative that ensures product safety and longevity use. 2. Caprylhydroxamic acid in combination with caprylyl glycol and glycerin to provide gentle, broad spectrum antimicrobial preservation. |
| **Porphyra (Bangiales, Rhodophyta)** | **Edible seaweed** | Vitamin B12, Amino-acid | Daily UV protective care - Sun care - Anti-photo-aging care. [99] |
| **Lipids** | **Fruit** | **Linoleic acid, Oleic acid, Palmitic acid, Omega-3 fatty acids and Vitamins A, D, and Beta Carotene, Lecithin.** | 1. Avocado oil is very easily absorbed by the human skin, keeping it firm and smooth. 2. Avocados may help to protect the skin from harmful UV radiation. [100] |
| **Borage (Borago officinalis)** | **Seed** | **Borage oil, gamma-linoleic acid (GLA)** | 1. Borage oil stimulates skin cell activity and encourages skin regeneration. 2. Borage penetrates the skin easily and benefits all types of skin, particularly dry, dehydrated, mature, or prematurely aging skin. 3. Treat all kinds of skin inflammation including Eczema, dermatitis, psoriasis and rosacea. [101] |
| **Evening primrose oil (Oenothera biennis)** | **seed** | **gamma-linolenic acid (GLA)** | 1. Evening primrose skin oil discourages dry skin and premature aging of the skin 2. It soothes skin problems and inflammation. [101] |
| **Soybeans (Glycine max)** | **nuts** | fatty acids, protein, lecithin, | Used topically on the skin, soybean oil is a cost-effective moisturizer compared to other oils and has a natural SPF of 10 [91] [101] |
| **Glycosides** | **Root extract** | **Methyl and methyl anthranilate** | The Anthranilate are considered to be a photostable (non-degradable upon exposure to UV) class of sunscreens due to the intramolecular hydrogen bonding facilitated by the ortho position of the NH₂ group with respect to the ester substituent [102] [103] |
| **Resins** | **Rhizome** | **Curcumin (diferuloylmethane), polyphenolic compounds, curcuminoids, demethoxycurcumin** | 1. Curcumin can prevent UV irradiation-induced apoptotic changes in human epidermoid carcinoma A431 cells. 2. Curcumin possesses anti-inflammatory, antitumoral, and antioxidant properties. [104] [25] |
| **Saffron (Crocus sativus)** | **powder** | homosalate | Saffron can be used as a natural UV absorbing agent [107] |
and the crude extract were incorporated in a gel-based sun protective formulation and analysed for the SPF. Oral administration of selenium, alpha-tocopherol, lycopene and β carotene has demonstrated reduced lipid peroxidation, erythema and formation of sunburn cell on induction by UV rays. Carotenoid like zeaxanthin/ β-carotene/ canthaxanthin extracted from the thermotolerant genera synechocystis, pevalkei is screened for production of UV protective compound and their role in skin protection. Juglone are made from fresh shell of English walnut, Juglans regia. Juglone is predominantly used as a self-tanning agent apart from its sunscreen potential and have antioxidant property. The chemical structure of terpenoids containing compounds as shown in Figure 3.

Antioxidants

Many phytochemical sunscreen acts as antioxidants including Vitamin C and E, green tea polyphenols and silymarin. Vitamin C (as shown in Figure 4) protects against UV damage, which result in sunburn and erythema. Vitamin E also has many protective action like decreasing immunosuppression, photoaging and photo carcinogenesis. Amla is a fruit extract (1-O-Galloyl-β-D-glucose (β-Glucogallin), β-Glucogallin) have photoprotection efficacy due to its inhibitory effect on ultraviolet radiation. It contains β-glucogallin so significantly responsible for the photoprotection efficacy and have strong antioxidant activities against the UV penetration and anti-aging.

Resveratrol- Belongs to qualify polyphenolic compounds. It is fat soluble and shows anti-mutagen and antioxidant properties and also shows anti-ageing properties. It is mainly found in wine, grape skin, berries juice and peanut products. It is very abundant in the roots of weed Polygonum cuspidatum and also in leaves of Veratrum grandiflorum. Resveratrol also delay the skin tumorgenesis and inhibit the UVB induced tumour incidence. It also induces the human promyelocytic leukemia cell differentiation.

Ascorbic acid- this is also known as vitamin C. Ascorbic acid helps in adding protection against acute UVB damage. So it is also used in sunscreen for better protection and also sold as a dietary supplement. Lycopene - It is a plant nutrient with antioxidant properties mainly found in red and pink fruits like tomatoes, pink grapefruit, watermelons. Lycopene linked to heart healthy properties. Test tube study showed that lycopene slows down the growth of breast cancer by limiting tumor growth.

Lipids

Lipids are a various and prominent group of natural biological compounds and also found in animal, plants and micro organisms. It present in cosmetic formulation to be applied to skin or protect the skin and enhance the body appearance, create protection barriers on the skin from harmful external substance and also help to it keep soft and hydrated. The major natural ingredients present are lipids plant oil and fatty acids. Plant oil such as Avocado oil (Persea americana), Borage oil (Borago officinalis), Evening primrose oil (Oenothera biennis), Soybeans oil (Glycine max). Plant oil carry main major constituents like Linoleic acid, Oleic acid, Palmitic acid, Omega-3 fatty acids and Vitamins A, D, and Beta Carotene. Lecithin. The action of Avocado oil herbal formulation is that it is very easily absorbed by the human skin, keeping it firm and smooth and also avocados may help to protect the skin from harmful UV radiation. Borage oil carry main constituents that is gamma-linoleic acid (GLA). Borage oil has various application in skin formulations. It boosts regeneration of skin and also rouses cell activity. It deeply enters to the skin and therefore helpful for preventing inflammation including Eczema, dermatitis, psoriasis and rosacea in different skin types including, dehydrated, dry, prematurely aging and mature skin. Evening primrose oil also contain GLA as active constituent.

Figure 1: Depicting an overview on harmful effects of UV radiations and ways of protection including herbal agents as sun screening agents.

Figure 2: Chemical structure of flavonoids derivatives.
Anthraquinone Glycosides: There are naturally occurring phenolic glycosides such as tryptophan and its analogues. They have the ability to protect themselves from UV radiations due to the presence of active pharmacophores such as antioxidants, lipids, vitamins, terpenoids, flavonoids, lipids, resins, phenolic acid, amino acid, and enzymes etc. Therefore, present study reveals the potential of natural plant constituents and their effects against UV induced sun burns, cancers etc. The discovery of newer naturally derived sunscreens requires further intensive work by researchers. Therefore, the present paper may be helpful for the researchers and scientists to discover and formulate newer plant derived chemicals with sun protection activity with a target of minimum cost and high efficacy.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ABBREVIATIONS

UV: Ultra violet; WHO: World Health Organisation; SPF: Sun Protection Factor; FDA: Food and Drug Administration; IUPAC: International Union of Pure and Applied Chemistry.

REFERENCES

1. Gallay C, Dumont S, Kherad O. Effectiveness of sunscreen against melanoma. Rev Med Suisse. 2019;15(635):198-201.
2. Maglio GD, Paz M, Leoni J. Sunlight effects on immune system: Is there something else in addition to UV-induced immunosuppression? Bio Med Research International. 2016;2016.
3. Pääkkonen R, Korpinen L, Gobba F. Examples of UV Measurements under 400 kV Powerlines in Finland. PIERS Proceedings; 2013.
4. Latha M, Marta J, Shobha V, Shinde RS, Bangera S, Krishnakutty B, et al. Sunscreening agents: A review. The Journal of Clinical and Aesthetic Dermatology. 2013;6(1):16.
5. Gonzaga ER. Role of UV light in photodamage, skin aging, and skin cancer. American Journal of Clinical Dermatology. 2009;10(1):19-24.
6. Saladi RN, Persaud AN. The causes of skin cancer: A comprehensive review. Drugs of Today. 2005;41(1):37-54.
7. Puzinna-Ivic N. Skin aging. Acta Dermatovenereologica Alpina Panonica Et Adriatica. 2008;77(2):47.
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Camellia sinensis
Emblica officinalis

Pharmacognosy Reviews, 2012;6:30.

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22.
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72. Giacomoni PU. Sun protection in man: Elsevier; 2001.

73. Suryati HN, Rachmanus MHNHL. Characterization antibacterial constituent from Ficus deltoideus Jack leaves Karakterisasi konstiten antibakt dari daun Ficus deltoideus Jack. Majalah Farmasi Indonesia. 2010;21(10).

74. Arbie S, Sulharni N, Wahyuningish I. Formulasi krim m/a dengan variasi Konsentrasi ekstrak buah pepaya (Carica papaya L.) Menggunakan emulgator asam stearat dan trietanolamin. Media Farmasi. 2020;16(1):97-104.

75. Carini M, Aldini G, Orioli M, Facino RM. Antioxidant and photoprotective activity of a lipophilic extract containing neolignans from Krameria triandra roots. Planta Medica. 2002;68(8):795-8.

76. Patel NR, Highton A, Moy RL. Properties of topical sunscreen formulations: A review. The Journal of dermatologic surgery and Oncology. 1992 Apr;18(4):318-20.

77. Mills C, Cleary BV, Walsh JJ, Gilmer JF. Inhibition of acetylcholinesterase by tea tree oil. Journal of Pharmacology and Pharmacotherapy. 2004;5(3):375-9.

78. Dweck A. Comprehensive focus on natural dyes. Colour Cosmetics. 2005;9-69.

79. Csomulescnu SN, Trandafir I, Achim G, Mihai B, Baciu A, Gruiu M. Phenolics of green husk in mature walnut fruits. Notulæ Botanicae Horti Agrobotanici Cluj-Napoca. 2010;38(1):53-6.

80. Darr D, Dunston S, Faust H, Pinnell S. Effectiveness of Antioxidants (Vitamin C and E) With and. Acta Derm Venereol. 1996;76:264-8.

81. Ren S, Lien EJ. Natural products and their derivatives as cancer chemopreventive agents. Progress in Drug Research/Fortschritte der Arzneimittelforschung/ Progrés des recherches pharmaceutiques: Springer. 1997;147-71.

82. Ndiaye M, Philippe C, Mukhtar H, Ahmad N. The grape antioxidant resveratrol for skin disorders: Promise, prospects, and challenges. Archives of Biochemistry and Biophysics. 2011;508(2):164-70.

83. Sunde R, Bowman B, Russell R. Present knowledge in nutrition. Washington, DC, [LSJ], 2006.

84. Trumbo P, Yates AA, Schicker S, Poos M. Dietary reference intakes: Vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Journal of the Academy of Nutrition and Dietetics. 2001;101(3):294.

85. Wang SQ, Dusza SW, Lim HW. Safety of retinyl palmitate in sunscreens: A critical analysis. Journal of the American Academy of Dermatology. 2010;63(5):903-6.

86. Wang SQ, Dusza SW, Lim HW. Safety of retinyl palmitate in sunscreens: A critical analysis. Journal of the American Academy of Dermatology. 2010;63(5):903-6.

87. Bensouilah J, Buck P. Aromadermatology: Aromatherapy in the treatment and care of common skin conditions: Radcliffe Publishing. 2006.

88. Sahasrabuddhe SH. Lycopeno-An Antioxidant. Pharma Times. 2011;43(12):13-5.

89. Stahl W, Heinrich U, Aust O, Tronnier H, Sies H. Lycopeno-rich products and dietary photoprotection. Photochemical and Photobiological Sciences. 2006;5(2):238-42.

90. Goswami PK, Samant M, Srivastava R. Natural sunscreen agents: A review. Sch Acad J Pharm. 2013;2(8):488-63.

91. Basu A, Penuguona K. Pomegranate juice: A heart-healthy fruit juice. Nutrition Reviews. 2009;67(1):49-56.

92. Weerakody P, Jobling J, Infante MMV, Rogers G. The effect of maturity, sunburn and the application of sunscreens on the internal and external qualities of pomegranate fruit grown in Australia. Scientia horticulturae. 2010;124(1):57-61.

93. Maheshwgar V, Patil B, Dhimal P. Comparative sun protection factor determination of fresh fruits extract of Cucumber vs marketed cosmetic formulation. Research Journal of Pharmaceutical Biological and Chemical Sciences. 2010;1(3):55-9.

94. Ashawat M, Saraf P. Comparative sun protection factor determination of fresh Aloe vera gel vs marketed formulation. Indian Journal of Pharmaceutical Educational and Research. 2008;42(4):319-22.

95. Shenyay PA, Khot SS, Chavan MC, Takavale JV, Singh S. Study of sunscreen activity of aqueous, methanol and acetone extracts of leaves of Pongamia pinnata (L.), fabaceae. International Journal of Green Pharmacy. 2010;4(4).

96. Patil VV, Patil S, Kondawar M, Naikwade N, Madgum C. Study of methanolic extract of flower of Spathodea campanulata L. as an anti-solar. International Journal of Green Pharmacy (IJGP). 2009;3(3).

97. Barcroft A, Myśkoja A. Aloe vera: Natur’s silent healer: Alasdair Aloe vera. 2003.

98. Bhatia S, Sharma K, Namdeo AG, Chisugule B, Kavale M, Nanda S. Broad-spectrum sun-protective action of Porphyra-334 derived from Porphyra vietnamensis. Pharmacognosy Research. 2010;2(1):45.

99. Svishter HE. Avocado oil. J Am Oil Chem Soc. 1988;65(11):1.

100. Wilson R. Aromatherapy: Essential oils for vibrant health and beauty: Penguin; 2002.

101. Jackson KM, DeLeon M, Verret CR, Harris WB. Dibenzoylemethane induces cell cycle deregulation in human prostate cancer cells. Cancer Letters. 2002;178(2):161-5.

102. Schauder S, Ippen H. Phototoxic and allergic contact dermatitis from dibenzoylemethan. Photo-dermatology. 1986;3(3):140-7.

103. Garcia-Borros A, Avila JG. Natural products: Molecular mechanisms in the photochemoprevention of skin cancer. Rev Latinoamer Quím. 2008;36:83-102.

104. Villalobos-Hernandez J, Muller-Gymann C. In vitro erythematous UV-A protection factors of inorganic sunscreens distributed in aqueous media using carnauba wax–decyl oleate nanoparticles. European Journal of Pharmaceutics and Biopharmaceutics. 2007;69(1):122-5.

105. Rodrigues N, Cole-Filipiak N, Horbury M, Staniforth M, Karsli T, Peperstraete Y, et al. Photophysics of the sunscreen ingredient menthol anthranilate and its precursor methyl anthranilate: A bottom-up approach to photoprotection. Journal of Photochemistry and Photobiology A: Chemistry. 2018;353:376-84.

106. Golmohammadzadeh S, Jaafar MR, Hosseinzadeh H. Does saffron have antisolar and moisturizing effects?. Iranian Journal of Pharmaceutical Research: UPR. 2010;9(2):133.

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