

**A REVIEW - HERBAL SUNSCREEN AGENTS ON SKIN PROTECTION****\*D. Anitha, <sup>1</sup>Kolavali Yalla Reddy, <sup>2</sup>P. Venkatesh and <sup>3</sup>M. Jhansi Raani**

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**ABSTRACT**

Sunscreen is defined as substance that protects the skin from excessive exposure to the ultraviolet radiation of the sun. The exposure of skin to ultraviolet radiation has a destructive effect on keratinocytes by causing DNA damage that can subsequently lead to causes the cancer, erythema, edema, hyperpigmentation, photoaging, weakening of immune system and melanoma. Sunscreen agents are proposed for sun protection because of their ability to block UV-induced sunburns. It helps to prevent sunburn and reduce the harmful effects of the sun such as premature skin aging and skin cancer. Sunscreens are used to aid the body's natural defense mechanisms to protect against harmful UV radiation from the sun. Its function is based on its ability to absorb, reflect or scatter the sun's rays. Several synthetic organic sunscreen agents are available in the market but they have limited use because these agents may create adverse effects on human skin. To overcome these side effects, naturally occurring compounds like antioxidants (vitamin C, vitamin E), flavonoids, carotenoids and phenolic acids play the main role in fighting against free radical species that are the main cause of numerous negative skin changes. These natural isolated plant compounds and whole herbal extracts have gained considerable attention as sun protective agents.

**KEYWORDS:** UV radiation, Keratinocytes, Vitamin C, Protective agents.**INTRODUCTION**

Sunscreen is defined as substance that protects the skin from excessive exposure to the ultraviolet radiation of the sun. The over exposure of skin to ultraviolet radiation has a destructive effect on keratinocytes by causing DNA damage that can subsequently lead to causes the cancer, erythema, edema, hyperpigmentation, photoaging, weakening of immune system and melanoma.<sup>[1]</sup> UV Radiation is a carcinogen. The two types of UV radiation that affect the skin known as Ultra violet A, Ultra violet B and Ultra violet C have been linked with the skin cancer, immunosuppression and melanoma.<sup>[2]</sup> The ultraviolet radiation (UVR) is divided into three categories dependent on wavelengths: short wavelengths UVC (200-280 nm), medium wavelengths UVB (280-320 nm), and long wavelengths UVA (320-400 nm).<sup>[3][4]</sup> In less severely affected cells, cell-cycle progression can be blocked and DNA damage can be repaired through nucleotide excision repair (NER). If repair is successful and cells have not suffered irreversible damage, they will survive. In the absence of appropriate repair, keratinocytes undergo apoptosis, producing characteristic sunburn cells.<sup>[5]</sup>

Sunscreen agents are proposed for sun protection because of their ability to block UV-induced sunburns. It

helps to prevent sunburn and reduce the harmful effects of the sun such as premature skin aging and skin cancer. Sunscreens are used to aid the body's natural defense mechanisms to protect against harmful UV radiation from the sun. Its function is based on its ability to absorb, reflect or scatter the sun's rays.<sup>[6]</sup> Several synthetic UV screen molecules are available in the market but they have limited use because these active molecules may produce severe adverse effects on human skin. These synthetic organic agents may produce photon induced reaction such as photoirritation, photosensitization and contact dermatitis by sunscreen products containing synthetic organic sunscreen agents.<sup>[7]</sup>

To overcome these side effects, naturally occurring compounds have gained considerable attention as photoprotective agents. Some groups of natural occurring compounds act as catalysts in the light phase of photosynthesis and as stress protectants in plant cells by scavenging reactive oxygen species (ROS). The exposure of skin to UV radiation results in the generation of ROS and reactive nitrogen species (RNS). The predominant ROS produced upon UV radiation are hydroxyl radical, superoxide anion and peroxy radical and their active precursors namely singlet oxygen, Hydrogen peroxide and ozone.<sup>[8]</sup> ROS are constantly generated in

keratinocytes and fibroblasts, and are rapidly removed by nonenzymic and enzymic antioxidant substances to prevent the living system from the harmful effects of free radicals. These maintain a prooxidant/antioxidant balance results in the stabilization of cell structure. Excess of free radicals results in a cascade of events mediating progressive deterioration of cellular structure and function lead to a loss of cellular integrity by modification of DNA and also to abnormal expression of cellular genes.

The naturally occurring compounds like antioxidants (vitamin C, vitamin E), flavonoids, carotenoids and phenolic acids play the main role in fighting against free radical species that are the main cause of numerous negative skin changes.

### ANTIOXIDANTS

Antioxidants may be defined as radical scavengers. This protects the human body against free radicals. Free radicals may cause pathological conditions like anaemia, asthma, arthritis, inflammation, neuro degeneration, parkinson's disease, mongolism, ageing and dementias.

These antioxidant compounds are obtained from natural foods and vit-C and E, carotene and tocopherol.<sup>[9]</sup> Antioxidants are natural plant and animal derived compounds and enzymes that minimize or repair the damage to our cells from oxidative stress. Plant based foods like fruits, vegetables, juices, whole grains, nuts, seeds, herbs and spices, and they are also found the meat and sea foods. Some of the foods contain high antioxidants these are like blueberries, strawberries, apples, potatoes, kidney beans, plums and cherries.

### Flavonoids

Flavonoids are the secondary metabolites from plant phenolics shows significant antioxidant properties. These substances were known for their beneficial effects on health. More than 3000 varieties of flavonoidal compounds were isolated and identified, many of which are responsible for the attractive colors of flowers, fruit, and leaves.<sup>[10]</sup> Apart from various vegetables and fruits, flavonoids are found in seeds, nuts, grains, spices, and different medicinal plants as well in beverages, such as wine, tea, beer. In plant, flavonoids play different roles in biological systems are prescribed to their capacity to transfer electrons free radicals.<sup>[11]</sup>

### Carotenoids

Carotenoids from a healthy unsupplemented diet accumulate in the skin and their level significantly correlates with sun protection. Eating large quantities of fish oil appears to provide a sun protective effect, may reduce the UV-induced inflammatory response by a lowered prostaglandin E2 levels in human fibroblasts, lycopene,  $\beta$ -carotene, and lutein were all capable of significantly reducing lipid peroxidation caused by UVB. Carotenoids like lycopene, lutein,  $\beta$ -carotene,  $\alpha$ -

tocopherol may decreased UV-induced erythema, lipid peroxidation, and sunburn cell formation.<sup>[12]</sup>

### Phenolic compounds

Phenolic compounds constitute a group of secondary metabolites which have important functions in plants. Besides the beneficial effects on the plant host, polyphenols exhibit a series of biological properties that influence the human in a health promoting manner. These are useful to treat skin disorders due to their natural origin and low toxicity, it promotes the eliminating the causes and effects of skin damage, skin aging and skin diseases. Approximately 8000 naturally occurring compounds are available, which possess one common structural feature, a phenol (an aromatic ring bearing at least one hydroxyl substituent). These are commonly found in herbs and fruit (e.g. berries, apples, citrus fruit, cocoa, grapes, apricots, peaches, cherries, plums), vege-tables (e.g. onions, olives, tomatoes, broccoli, lettuce, soybeans, nuts, spinach, cabbage, artichokes, eggplants), grains (e.g. wild rice), tea (green and black), coffee beans, propolis and red wine as a colour and flavouring agents and are an integral part of human diet.<sup>[13]</sup>

### NATURAL SUNSCREEN AGENTS

#### *Lycopersicon esculentum* (solanaceae)

Tomato (*Lycopersicon esculentum*) fruit belongs to family solanaceae. It is the major source of lycopene and studied for its antioxidant activity in cosmetic and pharmaceutical field. It is a powerful antioxidant,<sup>[14]</sup> and anti-carcinogenic carotenoid with strong reducing ability. Lycopene is a carotenoid, which gives red color to the tomatoes. It is not merely a pigment but a powerful antioxidant, neutralizes free radicals especially those derived from oxygen, present under the lipid membrane and skin cover. 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).<sup>[15]</sup>

#### *Aloe vera* (Liliaceae)

The leaves of *Aloe vera* and *A. barbadensis* are belongs to family Liliaceae *Aloe vera* gel is widely used in cosmetics and toiletries for its moisturizing and revitalizing action. It blocks both UVA and UVB rays and maintain Skin's natural moisture balance. The enzyme bradykinase in aloes stops the sunburns and stimulate immune system intervention.<sup>[16]</sup>

#### *Spathodea companulata* (Bignoniaceae)

African tulip tree (*Spathodea companulata*) is an ornamental plant belongs to family along the roadsides of tropical Africa. The plant stem bark was previously reported to have anti-hyperglycemic, antimalarial, antioxidant as well as wound healing properties. The methanolic extract of flower of *Spathodea companulata*

for its anti-solar activity. The extract showed a prominent absorbance at 200-240 nm, while good absorbance at a range of 240-325 nm. The moderate absorbance was noted at the range of 310-340 nm. The result revealed 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.<sup>[17]</sup>

#### ***Punica granatum* (Lythraceae)**

Pomegranate (*Punica granatum*) belongs to family Lythraceae. It contains principle antioxidant polyphenols in its juice include the ellagitannins and anthocyanins. For preventing sun burn damage of pomegranate fruit was significant effect of the sun protective action.<sup>[18]</sup>

#### ***Vitis vinifera* (Vitaceae)**

Grapes fruit (*Vitis vinifera*) belongs to family Vitaceae. It is the richest source of polyphenols (60%-70%). The skin and seeds of grapes also contains the polyphenolic phytoalexin namely resveratrol (trans-3, 5, 4'-trihydroxystilbene). It is an excellent antioxidant with strong anti-inflammatory and antiproliferative activity.<sup>[19]</sup>

#### ***Prunus dulcis* (Rosaceae)**

Almond is commercially known as almonds. Seeds are rich in polyphenolic compounds especially flavonoids and phenolic acids. The UVB protective property of this plant's skin extract was tested. The mice was exposed to UVB radiation and analyzed for changes in lipid peroxidation and glutathione levels. Topical application of formulated cream to mice after irradiation and 2h prior to irradiation showed the decreased levels of lipid peroxidation and increased levels of glutathione. The results showed that topical application of cream formulation has significant antioxidant and anti-photo aging properties.<sup>[20]</sup>

#### ***Glycine Max* (Fabaceae)**

Soybeans (*Glycine Max*) are a nutritious and cost-effective addition to sunscreen. Soybeans originally come from China and are a rich source of essential fatty acids, protein, lecithin, iron and calcium in the diet. When used topically on the skin, soybean oil is a cost-effective moisturizer compared to other oils and has a natural SPF of 10.<sup>[21]</sup>

#### ***Cucumis sativus* (Cucurbitaceae)**

Cucumber (*Cucumis sativus*) extract has strong moisturizing abilities as well as mild astringent effects. 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. Cucumber also contains ascorbic acid (vitamin C) and caffeic acid, both of which soothe skin irritations. These two acid compounds prevent water retention, which is why cucumbers applied topically are helpful for swollen eyes, burns and dermatitis.<sup>[22]</sup>

#### ***Camellia sinensis* (Theaceae)**

Green tea is obtained from the fresh leaves of the plant *Camellia sinensis*. Polyphenols are thought to be the major chemo preventive mediators. Green tea contains four major polyphenols: (-)-epicatechin (EC), (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC), and (-)-epigallocatechin-3-gallate (EGCG). It also contains other agents include caffeine, flavonoids, phenolic acids as well as the alkaloids theobromine and theophylline. The first evidence that green tea polyphenols might have a protective role in UV induced skin cancer came from studies by Wang et al., who showed that green tea administered in the drinking water to SKH-1 hairless mice had a dose-dependent prolongation in the mean time of tumor development when they were subjected to a photo carcinogenesis protocol. Very little absorption by green tea in the UVB or UVA range; it is effective when given systemically; and protection against at least some of the biological effects of ultraviolet radiation occur when green tea is applied immediately after exposure.<sup>[23][24]</sup>

#### ***Emblica officinalis* (Phyllanthaceae)**

*Emblica officinalis* Gaertn, commonly known as amla, is a rich dietary source of vitamin C, minerals and amino acids.<sup>[25]</sup> It also contains various phenolic compounds. Amla extract is known to exhibit potent antioxidant properties and to provide protection for human dermal fibroblasts against oxidative stress and therefore, it is assumed to be useful for natural dermal care.<sup>[26]</sup> Recently, it was reported that amla extract has effect on human skin fibroblasts, especially production of procollagen and matrix metalloproteinases (MMPs). The water extract from dried amla powder contains 2% ascorbic acid and 29.4% polyphenols including gallic acid and elaeocarpusin. Amla extract elevates the mitochondrial activity of human skin fibroblasts and promotes production of procollagen. Therefore, due to its potential mitigative, therapeutic and cosmetic applications, amla has been used for skin treatment since ancient times.<sup>[27]</sup>

#### ***Crocus sativus* (Iridaceae)**

Saffron, the dried stigma of the plant *Crocus sativus* L, popularly used as a spice and food colorant, has been used in traditional medicine for the treatment of many diseases including tumors. The chemical constituents of saffron include the colored carotenoids - crocin and crocetin - and the monoterpene aldehydes - picrocrocin and saffranol.<sup>[28]</sup>

#### ***Piper longum* (Piperaceae)**

*Piper longum* L. belonging to the family Piperaceae, is commonly found in Indonesia, India and the Phillipines. It consists of a spike of fruits forming a structure about 4 cm long and 6 mm in diameter. The fruit (pepper) contains 1 - 2.5 % volatile oil, 5 - 95 % of crystalline alkaloid piperine and piperettine, and a resin. Piperine extracted from this plant has been used as an ingredient in Ayurvedic formulations because of its antioxidant potency both *in vitro* and *in vivo* in mice. Piperine, due to

this antioxidant property, is used topically in a cream base to treat sunburn diseases.<sup>[29]</sup>

#### ***Terminalia chebula* (Combretaceae)**

*Terminalia chebula*, also called Harde, belongs to the family Combretaceae. It is used commonly in many Ayurvedic preparations as laxative, diuretic and cardiogenic, as well as in some health supplements. Its chemical constituents include ascorbic acid, gallic acid and ellagic acid, which are well known to exert free radical scavenging properties.<sup>[30]</sup>

#### ***Sesamum Indicum* (Pedaliaceae)**

*Sesamum Indicum* (Pedaliaceae) is an herb. It shows significant antioxidant property. *Sesamum Indicum* as a brain tonic, and as an antioxidant capable of treating amnesia and various skin problems and having property for improving memory. It contains major active constituents protein, carbohydrates, vitamins, riboflavin, nicotinic acid, pantothenic acid and ascorbic acid. Sesame oil is rich in oleic and linolic acids. Mainly two constituents are sesamin and sesamol, sesame oil having the antioxidant activity.<sup>[31]</sup>

#### ***Salvia lavandulaefolia* (Lamiaceae)**

*Salvia Lavandulaefolia* (*Spansih sage*) (Lamiaceae) is beneficial effects depression and cerebral ischemia, skin disorders, anti cholinesterase activity (helps the supplementation of ACh. *Salvia* majorly contains essential oils, 1, 8-cineole, linalool,  $\alpha$ - and  $\beta$ -pinene, carvacrol, luteolin. *Salvia Lavandulaefolia* has been reported to be antioxidant. It also helps remove dead skin cells and tightens skin.<sup>[32]</sup>

#### ***Curcuma longa* (Zingiberaceae)**

*Curcuma longa* belongs to family Zingiberaceae commonly known as turmeric have been used for the culinary properties in Indian curries and used as remedy against ageing. An aqueous extract of the rhizome demonstrated antidepressant activity in mice following oral administration which is associated with inhibition of brain MAO type A. Antidepressant activity is of significant importance in the management of AD.<sup>[33]</sup>

#### ***Capparis spinosa* (Capparaceae)**

The flower buds of *C. spinosa* have been used for several purposes since ancient times. These plants are widely distributed in tropical or subtropical as well as arid areas of the World. The major constituents of lyophilized extract of *C. spinosa* (LECS) have been identified as kaempferol and quercetin derivatives and caffeic, ferulic, p-cumaric, and cinnamic acids. LECS show significant antioxidant effect. Topically applied LECS reduces UVB-induced skin erythema in healthy human volunteers.<sup>[34]</sup>

#### ***Oenothera biennis* (Onagraceae)**

Evening primrose (*Oenothera biennis*) oil has a high GLA content that promotes healthy skin and skin repair. It is usually yellow in color. It soothes skin problems and

inflammation, making it a good choice for people with eczema, psoriasis, or any type of dermatitis. Evening primrose skin oil discourages dry skin and premature aging of the skin.<sup>[35]</sup>

#### ***Luffa cylindrica* (Cucurbitaceae)**

*L. cylindrica* (Linn) M. Roem. is a climber with a slender, slightly hairy stem with little furrowing. The seeds of *L. cylindrica* contain oil in which the fatty acids are stearic and linoleic acids – are unsaturated fatty acids.<sup>[36]</sup> It has been reported that naturally occurring unsaturated fatty acids and phenolic compounds have free radical scavenging properties.

#### ***Glycyrrhiza glabra* (Leguminaceae)**

The roots and rhizomes of *Glycyrrhiza glabra* is an efficient sun protective from the UV radiation. The root contains saponin glycosides mainly Glycyrrhetic acid, Stearyl glycyrrhetinate, protective effect of liquorice extract may be attributed to its antioxidant property by virtue of which susceptible skin exposed to less oxidative stress resulting due to exposure the UV radiation.<sup>[37]</sup>

#### ***Ocimum basilicum* (Lamiaceae)**

*Ocimum basilicum* belongs to family (Lamiaceae). It is native through the subtropics, especially throughout the Mediterranean region. It is widely used in India, since the Ayurveda and Unani medicinal systems use it for the treatment of several ailments. The essential oil of basil is reported to have various properties like antioxidant,<sup>[38]</sup> and anti-inflammatory activities. *Ocimum basilicum* shows significant sunscreen activity of basil oil.<sup>[39]</sup>

### CONCLUSION

The skin is over exposed to UV radiation resulting in the generation of free radicals. These are damaged to various cellular molecules. The use of synthetic organic sunscreens as photoprotectives in the formulation is a common practice. But they have been producing numerous harmful effects; they are less desirable now a day. So the research should be focused in identifying the alternative source for synthetic sunscreens. The use of medicinal plants as sun protectives has been gaining significant action, safety, multiple biological actions on the skin. In addition, the plant based compounds are preferred over the chemical sunscreens due to the broad spectrum of UV absorption, protective effect against oxidative stress, inflammation and cancer. The additions of preservatives, stabilizers are exerted by the active constituents of plant activities make them as the most suitable ingredient for sunscreen formulations. Concerted focus is now needed in the immediate future for exploring the herbals with potent sun protective activity.

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