HERBAL PLANTS IN PHOTO PROTECTION AND SUN SCREENING ACTION: AN OVERVIEW

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ABSTRACT

Harsh synthetic chemicals and pollution tremendously affecting our life today, hence, nature has endowed us with its everlasting treasure of herbal ingredients. The review basically emphasis on various herbal ingredients which have potential for photo protection. Ultraviolet rays are the major cause of sunburn which further leads to dangerous skin cancer. Prohibition of U.V rays penetration can be achieved by use of herbal ingredients showing sun screening action. As compare to synthetic moites herbal shows reduced side effects, effective in chronic conditions, widespread availability at lower cost. Basically herb with Vitamin (A, C, E) flavonoids, polyphenols, carotenoids (Lycopene, β carotene), and phenolic acids enhance photo protection as they posses antioxidant action. These herbal ingredients inhibit free radical formation and neutralize reactive oxygen species (ROS) and enhance skin protection from harmful U.V rays. This review focuses on various herbs with active constituent responsible for photo protection. This review concludes damaging and harmful effects of UV rays, types of UV radiations and at last review concludes study of chemical constituents present in various herbals responsible for UV shielding effect.


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INTRODUCTION

Objective:
The purpose of sunscreen preparation is to resist skin from painful effects of sunburn and skin cancer [1]. UV radiations shows damaging and harmful effects on skin. UVA and UVB rays causes skin melanoma, sun burn, photo ageing, skin pigmentation and various painful effects. Hence there is need of agents reported to have UV shielding effect [1], [3]. Generally sunscreens are used to protect skin from damaging effects of sun rays. Herbal sunscreens are ecofriendly with no comedogenic and side effects [2].

UV Shielding agents:
Sunscreen known as sun blocker, sunburn cream etc. It is a topical product that absorbs or reflects some of the ultraviolet radiations on the skin exposed to sunlight and thus shows protection against sunburn. Depending on their mode of action sunscreens can be classified into two types [1], [2] [4].

1. Physical Sunscreen
2. Chemical Sunscreen

U.V RADIATIONS
Sun rays reaching to the surface of the earth have basically three types of radiations. Visible rays (400-700nm), U.V rays with shorter wavelength (200-400nm) and infrared radiations with longer wavelength (760-5100nm) [1-3]. U.V radiations particularly below 320nm are responsible for most damaging detrimental effects depending on length and frequency of exposure [2], [3].

A) U.V.A Rays: The Ageing Rays
- Penetrate deeply into the skin layers, damaging collagen and cells [1].
- Cause wrinkling, pigmentation and loss of elasticity of the skin [1], [2].
- Are not affected by weather or altitude [2].
- Are up to 50 times more prevalent than U.V.B rays [3].
• Increase risk of skin cancer [1, 2, and 3].

B) U.V.B Rays: The Burning Rays
• Mostly affect the outer layer of the skin [1].
• Cause sunburns and tanning that increase the risk of skin cancer [1 and 2].
• Vary with time of the day and seasons, and are stronger in summer [2].
• The SPF (sun protection factor) number of sunscreen indicates level of protection from U.V.B only [1, 2, and 3].

DAMAGING EFFECTS OF U.V RAYS

Chronic exposure to U.V radiation leads to damaging effects to skin. It causes sunburn and photo aging [1-4], [6]. Intermittent sunburn is major factor for malignant melanoma. However existing chemical sunscreen are comparatively less efficient and shows more side effects and toxicities. Chronic sun exposure causes squamous cell and basal carcinomas which shows damaging effects on skin. Acute exposure to sunrays leads to redness and pigmentation which may further aggravate to erythema and sunburn [2], [4], [6].

WHY HERBAL SUNSCREEN INGREDIENTS
There is evidence from regulatory agencies that though synthetic sun blocker have fast sun protective action but simultaneously it have potential risk associated with it [1-2], [4], [6]. Results from CDC held in 2007 reported that mothers with high levels of oxybenzone (Benzophenon-3) in their bodies were more likely to give birth to underweight baby girls. According to TGA (Therapeutic Goods Administration) study there is evidence that zinc oxide and titanium oxide can induce free radical formation in the presence of light and this may damage normal cells (photomutagenecity with zinc oxide) [3], [5]. It is beneficial to use herbal ingredient as they do not provoke allergic reactions, do not show any negative side effects, do not show any comedogenic effect [1], [3]. Herbal constituents can be easily incorporated in formulation [3]. They are more effective, rich with its stability safety, purity, cost effectiveness, easily available and found in large variety of plants [2], [4], and [5].

HERBAL INGREDIENTS: SUNCREENS
*Phyllanthus emblica* (Family – *Phyllanthaceae*)

*Phyllanthus emblica* is mostly used in Thai medicine for treatments of various diseases [6]. The fruits are reputed to contain high amount of ascorbic acid (vitamin c) [5-7]. It contains minerals, amino acids, calcium, iron, carotenes. It also contains mixture of polyphenols such as phyllembin, flavonoids, kaempferol [6], [8-9]. Due to presence of above chemical constituents aqueous extract of *phyllanthus emblica* shows free radical scavenging action [6], [7]. It effectively inhibits peroxide free radical production. Hence shows protective action against U.V radiation penetration [5], [7].

*Luffa cylindrica* (*Luffa aegyptiaca* Family - *cucurbitaceae*)

It is classified as a type of cucumber. It is also called Vietnamese gourd or Vietnamese luffa. Luffa is a subtropical plant [4]. The fruit contains triterpenoid saponins such as lucyosides A, B, C, D, E, F E and ginsenosides [5], [8]. The leaf contains triterpenoid saponins lucyin A, lucosides G,P,N,O,Q, 2-β hydroxyoleanoic acid, 3-o-β Dglycopyranosyl ,maslinic acid, flavonoids such as apigenin and polypeptides such as luffins, luffacylin [4-5], [8-9]. It contains various antioxidants
which show nourishing action to skin [10]. Its fruit is used in Guinea on tumours and swellings, and the fruit pulp is used in Guinea and Nigeria as emollient. The seeds are credited with tumours and anthelmintic properties [4-5], [10]. The seed oil is used for treatment of skin problems like erythema, sun burn, and red pigmentation [5], [10].

Green Tea (*Camellia sinensis* Family - *Theaceae*)

Green Tea leaves are a popular nutraceutical used as an antioxidant [11]. Antioxidants are compounds that protect the cells from lethal effects of reactive oxygen species (ROS) such as superoxide, singlet oxygen, hydroxyl radicals [10-13]. This occurs due to penetration of U.V rays [11]. The basic chemical constituent in green tea includes catechins, vitamin E, tocopherols, carotinoids and polyphenolic compounds which shows potent antioxidant action and reported to be used as a herbal suncreening agent [8], [13].

Purslane (*Portulaca oleracea* Family- *Portulacaceae*)

Generally purslane is considered as a weed in U.S but it may be eaten as a leaf vegetable [5]. Purslane contains more omega-3-fatty acids, eicosapentaenoic acid (EPA) [4]. It also contains Vitamins mainly (vitamin A, C, E, B), α- linalenic acid and some of the carotinoids. Basically alkaloid pigments are present [14]. The reddish betacyanins and the yellow betaxanthins both of these pigments are potent antioxidants and have been found to have anti mutagenic property [5], [10].

Tomato (*Solanum lycopersicum* Family- *Solanaceae*)

Tomatoes are easily available and eaten freely throughout the world [15]. It basically contains carotene lycopene, which is most powerful natural antioxidant. Lycopene has also been shown to improve the skins ability to protect against harmful U.V rays [4-5], [14-16]. Tomato also contains various natural antioxidants, vitamin A, C, E, anthocynin, pantothenic acid and cryptoxanthin [4-5], [8-9], [14-16]. Due to presence of these constituents tomato shows strong protection against neurodegenerative diseases, blocks U.V. radiations and reported to be used as a herbal suncreening agent [15].
Myrobalan (*Terminalia chebulla* Family - **Combretaceae**)  
*Terminalia* is a tree. Three species of *Terminalia* are used for medicine. These are *Terminalia billerica*, *Terminalia chebulla*, *Terminalia arjuna*. *Terminalia chebulla* basically contains various phytochemicals such as polyphenols, α-tocopherols, anthocyanins, terpenes, flavonoids, alkaloids, and glycosides [8-9], [19]. It is reported to have therapeutic effect against skin disorders with discharges like allergies, urticaria and other erythematous disorders. A group of researchers have reported the inhibitory action on cancer cell growth [17-19]. It is found that phenolics, chebulinic acid, tannic acid and ellagic acid were precisely used for unwanted cell growth [8]. Aqueous extract of *Terminalia chebulla* inhibit xanthene oxidase activity and also reported to act as a scavenger of DPPH radicals. The strong antioxidant activity was studied by inhibition of radiation, lipid peroxidation, and scavenges hydroxyl and superoxide radicals and hence can be used as a U.V.radiation protectant [17], [18].

Carrot (*Ducus carota* Family - **Apiaceae**)  
Carrot is one of the most important root vegetable plants in the world. Predominantly β carotene the carotinoid it effectively quenches the free radicals specially singlet oxygen, superoxide anion and hydroxyl radicals [17], [21-22]. Which emphasis on the U.V protective nature of carrot. Other constituents include oxyacetylene, omega 3, 6, 9. Carrot seed oil, stigma sterol, β-sitosterol, vitamin A, campesteral which effectively enhance body’s immune response to U.V radiation, nourishes, rejuvenate skin and shows cytotoxicity against mutagens [8-9], [17], [20-22].

![β Carotene](image)

Manjistha (*Rubia cordifolia* Family - **Rubiaceae**)  
It is often known as Indian madder. Manjistha is another name of Indian madder [23]. The key chemical constituents of Indian madder include pseudo purpurin, munjistin, puroxanthin, flavonoids and free alizarin as well as glycoside [22-25]. These components are reported to impart beneficial effects in treating skin conditions like uneven pigmentation, hyperpigmentation, allergies, eczema and sunburn [23], [25]. Manjistha purifies the blood it is useful in blood originating diseases. It improves complexion of skin [22, 24, and 25].

![Alizarin](image)

Aloe Vera (*Aloe Vera* Family - **Xanthorrhoeaceae**)  
Aloe Vera is an incredible plant. It is a succulent plant belonging to liliaceous family [8], [26]. Its contains vitamin (A, C, E), minerals, amino acids, enzyme, polysaccharide, palmitic acid, oleic acid, caprylic acid, stearic acid, β sitosterol [8-9], [26], [27]. Aloe Vera is used on facial tissues to act as moisturizers, soaps, sunscreens, and suntan agent. The topical application of aloe Vera prevents radiation induced skin damage. Evidence tends to support that aloe Vera products should be an effective interventions used in burn and wound healing. Aloe is also an immune enhancer because of its high level of antioxidants, which help to react with unstable compound known as free radicals which shows positive action against U.V absorption. It is used as an antipruritic, astringent [17-19], [22], [26-27].

Walnut (*Juglans Regia* Family - **Juglandaceae**)  
Walnut is an edible seed of genus juglans [8]. Walnut seeds basically contain amino acids, carbohydrates, unsaturated fatty acids; walnut oil is rich in polyunsaturated fatty acids, linolenic acid, linoleic acid, glyceryl triacylates and mostly antioxidants [19], [22]. Its aqueous extract has shown to be effective as a self tanning sunscreen agent. Its main chemical constituent juglone have reported to have action with keratin proteins of skin. Walnut is reported to have U.V rays protecting activity [17], [19], [22], [26]

Damask rose (*Rosa damascene* Family - **Rosaceae**)  
The flowers are renowned for their fine fragrance, used in perfumery and cosmetics [28]. The chemical composition of rose oil is one of the most complexes; basically it contains citronellol, geraniol, nerol, stearpoten, phenyl ethanol, and traces of
nonanal, linalool. Rose oil blended with cream or lotion [10], [27-28]. It stimulates the skin, while moisturizing and hydrating, beneficial to dry, mature and sensitive skin [10]. It helps to reduce skin redness, fight inflammations as well as fix broken capillaries on the skin. It is reported to have activity against U.V rays penetration [28].

\[
\begin{align*}
\text{Citronellol} & : \quad \ce{CH3-C(\ce{CH2}=\ce{CH})-CH2OH} \\
\text{Nerol} & : \quad \ce{CH3-C\lbrack=CH-C\lbrack=CH-\ce{CH3}\rbrack\cdot CH3} \\
\end{align*}
\]

Porphyra (Bangiales rodophyta)

It is a type of algae, contains high levels of proteins. It synthesizes secondary metabolites such as mycosporine which is reported to have U.V absorbing action. Hence it can be used in sunscreen preparations [10].

Lemon (Citrus limonum Family- Rutaceae)

Lemon oil is obtained fruit of lemon. Lemon oil has a sharp, fresh smell is pale greenish yellow in colour and is watery in viscosity [8], [10]. The main chemical components of lemon oil are α-pinene, camphene, β-pinene, sabinene, myrcene, α-terpinene, linalool, β-bisabolene, nerol, neral, ascorbic acid which shows potent antioxidant action [8-10]. Lemon oil is used for acne, cleaning greasy skin and hair, as well as removing dead skin cells and emollient effect on sun burnt skin cells [10],[22].

\[
\begin{align*}
\text{Camphene} & : \quad \ce{C\lbrack=CH-C\lbrack=CH-\ce{CH3}\rbrack\cdot CH3} \\
\text{Bisaboline} & : \quad \ce{C\lbrack=CH-C\lbrack=CH-\ce{CH3}\rbrack\cdot CH3} \cdot \ce{CH3} \\
\end{align*}
\]

Pomegranate (Punica granatum Family- Lythraceae)

In the Indian ancient ayurveda system of medicine, the pomegranate has extensively been used as a source of traditional remedies for thousands of years [14]. Pomegranate arils provide 12% of daily value (DV) for vitamin C, 16% of vitamin K. It also contain polyphenols such as ellagitannins, punicalagins, granatin A and B, punicacotein A,B,C, punicafolin, punigluconin, punicalagin, punicalin and flavonoids with free radical scavenging properties. Punicalagins are absorbed in human body as antioxidants. [14], [27], [29]

Indian long pepper (Piper longum Family- Piperaceae)

Long pepper is a flowering vine cultivated for its fruit, which is usually dried and used as a spice and seasoning [8-9], [5]. The immunomodulatory potential of P.Longum piperine, methyl piperine, iperonaline, piperettine, asarinin, pellitorine and piperinic acid showed inhibition of tumour formation [8-9], [4-5]. A combination of spices (piper longum, zingiber officinale), herbs (cyperus rotundus and piumbago zeylanica) and salts make up amrita bindu were tested for antioxidant activity and U.V protectant action [4-5], [10], [27].

\[
\begin{align*}
\text{Asarinin} & : \quad \ce{NH\cdot CO\cdot CH\lbrack=CH\cdot CH\lbrack=CH-\ce{CH3}\rbrack\cdot O} \\
\text{Piperine} & : \quad \ce{O\cdot H\cdot \ce{C\lbrack=CH-C\lbrack=CH-\ce{CH3}\rbrack\cdot CH3}} \cdot \ce{CH3} \cdot \ce{CH3} \\
\end{align*}
\]

Apple (Malus domestica Family-Rosaceae)

Apple is the pomaceous fruit of the apple tree. Apple peels are a source of various phytochemicals with unknown nutritional value and possible antioxidant activity in vitro. The predominant phenolic phytochemicals in apples are quercetin,
epicatechin, procyanidin b-2 and many more flavonoids. This shows scavenging action towards free radicals produced due to U.V. radiation [22], [27].

Turmeric (*Curcuma longa* Family- zingiberaceae)

Turmeric is a rhizomatous herbaceous perennial plant of the ginger family [8-9], [30]. The most important chemical components of turmeric are a group of compounds called curcuminoids, which include curcumin, demethoxycurcumin and demethoxycurcumin [8-9], [30], [32]. In addition there are other important volatile oils such as turnerone, atlantone and zingiberene. Curcuminoids help to protect skin cells from free radical damage. It has strong capacity to scavenge the hydroxyl radical; it is considered to be the most reactive of all oxidants and shows U.V. protective action [30, 31, and 32].

Olive oil (*Olea europaea* Family- oleaceae)

Olive oil is a fat obtained from olive fruit. Olive oil is composed of triglyceride esters of oleic acid and palmitic acid along with traces of squalene, sterols, (phytosterols, and tocosterols). It also contains polyphenols such as esters of tyrosol and hydroxyl tyrosol including oleocanthal and oleuropein. Some sort of flavonoids and lignans are also present. Olive oil has a long history of being used as home remedy for skin care. Squalene is used as an antioxidant, moisturizer and as a convenient vehicle to carry other substances in topical sunscreen preparation [17], [19], [36].

Castor oil (*Ricinus communis* Family-Euphorbiaceae)

Castor oil is a vegetable oil obtained from seeds of castor. It is colourless to pale yellow liquid [8], [9]. It is a triglyceride in which 90% of fatty acid chains are ricinoleic. Oleate and linoleates is the other important compound. Castor oil is a famous as a source ricinoleic acid, monounsaturated, 18carbon fatty acid [8-9], [17]. Castor oil is a boon for all skin problems, as it reduces various problems like sunburn, acne, dry skin, stretch marks etc. It penetrates deep into the skin and
stimulates the production of collagen and elastin, which helps to soften and hydrate the skin. It rejuvenates and repairs skin, making it smooth, soft and youthful [22], [35]

**Argan Oil (Argania spinosa)**

Argan oil is plant oil produced from the kernels of the argan tree. It is valued for its nutritive, cosmetic and numerous medicinal properties. Argan oil contains tocopherols (Vitamin E), phenols, carotenoids, squalene and fatty acids. The main natural phenols in argan oil are caffeic acid, oleuropein, vanillic acid, tyrosol and catechol. Unroasted argan oil is traditionally used as a treatment for skin diseases and as cosmetic oil for skin. It is reported to have moisturizing, nourishing, U.V protectant and antioxidising benefits [22], and [35-37]

![Oleuropein](image1.png) ![Lecithin](image2.png)

**Sunflower Oil (Helianthus annuus)**

Sunflower oil is a non volatile oil compressed from sunflower seeds. It is used in cosmetic as a emollient. It basically contains MUFA, PUFA, omega 9, omega 6, Vitamin E, squalene, palmitic acid, stearic acid. Sunflower oil also contains lecithin, tocopherol, carotenoids and waxes. It retains moisture in the skin and protects skin from harmful U.V. radiations [8-9], [37]

**Borage seed oil (Borago officinalis)**

Borage seed oil is derived from the seeds of borago officinalis. It contains highest amount of γ-linolenic acid (GLA). Borage oil may contain pyrrolizidine alkaloid amabiline which is hepatotoxic so can be used in topical skin protectant cosmeceutical preparation [10].

![Amabiline](image3.png) ![Pyrrozilidine](image4.png)

**Evening primrose oil (Oenothera glazioviana Family- onagraceae)**

Evening primrose oil is the oil from the seeds of the oenothera glazioviana plant. The flower of many species open in the evening, hence the name evening primrose is used commonly [10]. Evening primrose oil is marketed in U.V. radiations induced cancer therapy. It contains γ linolenic acid which shows antioxidant property [38]

**Avocado oil**

Avocado oil is high in monounsaturated fats and Vitamin E. Avocado oil enhances the absorption of carotenoids and other nutrients. Originally it is extracted for cosmetic use because of very high skin penetration and rapid absorption [22], [28]. It is rich and extremely deep penetrating oil, rich in Vitamins A, D and E, lecithin as well as potassium. It is also having high content of sterolins, which are reported to reduce age spots, helps to heal sun damage and scars [10].

It is an ideal ingredient to include when formulating for people with dehydrated, sun or climate damaged skin, as it is extremely good moisturizing and nourishing compound assisting in the regeneration and rejuvenation of the skin. In a study done at the department of Food engineering and Biotechnology, Technion-Israel Institute of Technology in 1991, it was found that avocado oil significantly increase the amount of collagen in the skin which is normally under attack as we grow older [36], [38].

Avocado oil is easily absorbed into deep tissue, and with its wonderfully emollient properties makes it ideal for mature skins. It also helps to relieve the dryness and itching of psoriasis and eczema. It is very useful when treating sun or climate damaged skin that is dehydrated and under nourished, as it is said to help with regenerating the skin and softening the tissue [22], [36], [38].
UV Radiations cause various harmful and damaging effects on skin. It causes skin cancer, hyper pigmentation, photo ageing, sunburn and skin irritation. Herbal cosmeceuticals posses’s property to protect skin from damaging effects of sun rays with no comedogenic and side effects. The present review focuses on scientific account of herbals in cosmetics. Active constituents extracted from herbals having potent UV shielding effect. Herbs are ecofriendly, compatible and wide spread availability compared to synthetic ones.

REFERENCES