



University of Basra
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Plants Protect DNA From UV Damage And Scanning Their Using In Skincare And Cosmtic Products

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INTRODUCTION

Herbs have been used in medicines and cosmetics from centuries. Their potential to treat different skin diseases, to adorn and improve the skin appearance is well-known. As ultraviolet (UV) radiation can cause sunburns, wrinkles, lower immunity against infections, premature aging, and cancer, there is permanent need for protection from UV radiation and prevention from their side effects. Herbs and herbal preparations have a high potential due to their antioxidant activity, primarily. 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. [25]

TYPES OF ULTRAVIOLET RADIATION

UV radiation is classified into three primary types: ultraviolet A (UVA), ultraviolet B (UVB), and ultraviolet C (UVC). These groups are based on the measure of their wavelength, which is measured in nanometers (nm= 0.000000001 meters or 1×10^{-9} meters)

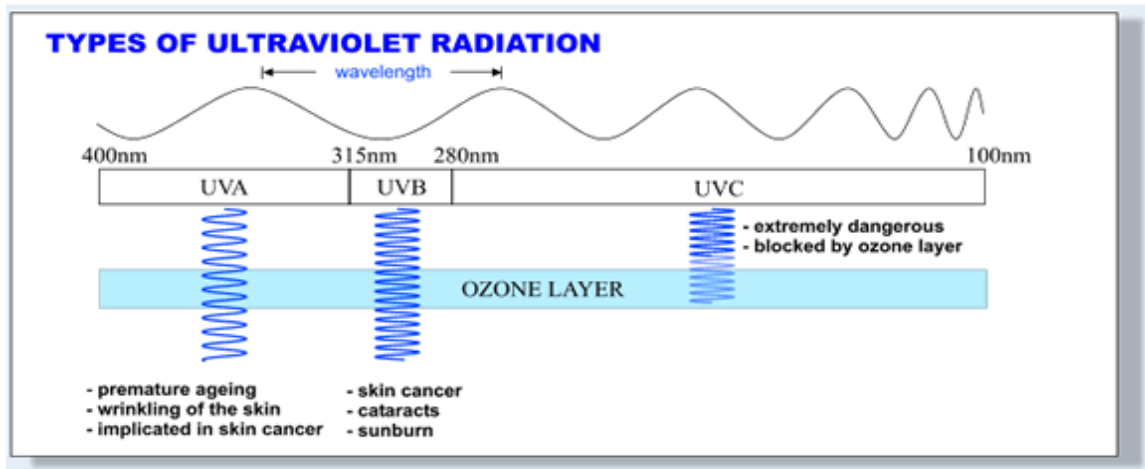


FIGURE (1) TYPES OF ULTRAVIOLET RADIATION

UVA RAYS

They have higher wavelengths, but lower energy levels than other UV rays. They're more penetrating than UVB rays, which means they can affect cells deeper in the skin. They cause indirect damage to DNA. They cause skin to age prematurely, leading to visible effects such as wrinkles. They're also

associated with some skin cancers. Unlike UVB rays, they're not absorbed by the ozone layer. About 95 percent of the UV rays that reach the ground are UVA rays. They cause an immediate tanning effect, and sometimes a sunburn. The effects of UVA rays tend to appear right away. UVA rays are the main type of light used in tanning beds. They can penetrate windows and clouds.[22]

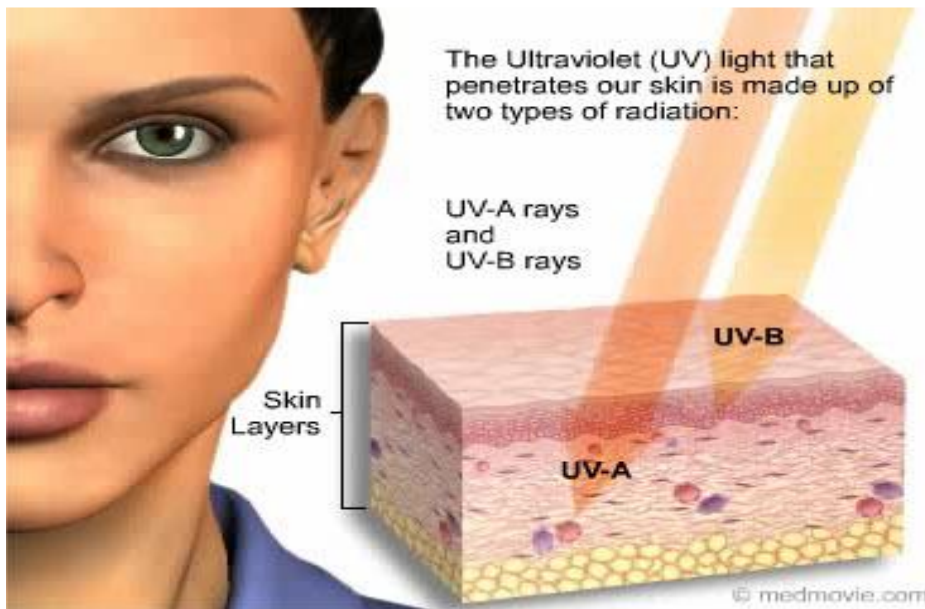


FIGURE (2) THE ULTRAVIOLET LIGHT THAT PENETRATES OUR SKIN

UVB RAYS

Relative to UVA rays, UVB rays have shorter wavelengths and higher energy levels. UVB rays damage the outermost layers of the skin. They directly damage DNA. UVB rays cause most skin cancers, but they can also contribute to skin aging prematurely. They're partially absorbed by the ozone layer, but some rays still get through. About 5 percent of the UV rays that reach the ground are UVB rays. Over exposure to UVB rays leads to sunburns. Usually, the effects of UVB rays are delayed, or appear a few hours after sun exposure. Most tanning beds use a combination of UVA and UVB rays. Special UVB-only tanning beds may be touted as safe, but they still cause skin damage. No tanning beds are safe to use or recommended. They don't penetrate windows, and are more likely to be filtered by clouds.[22]

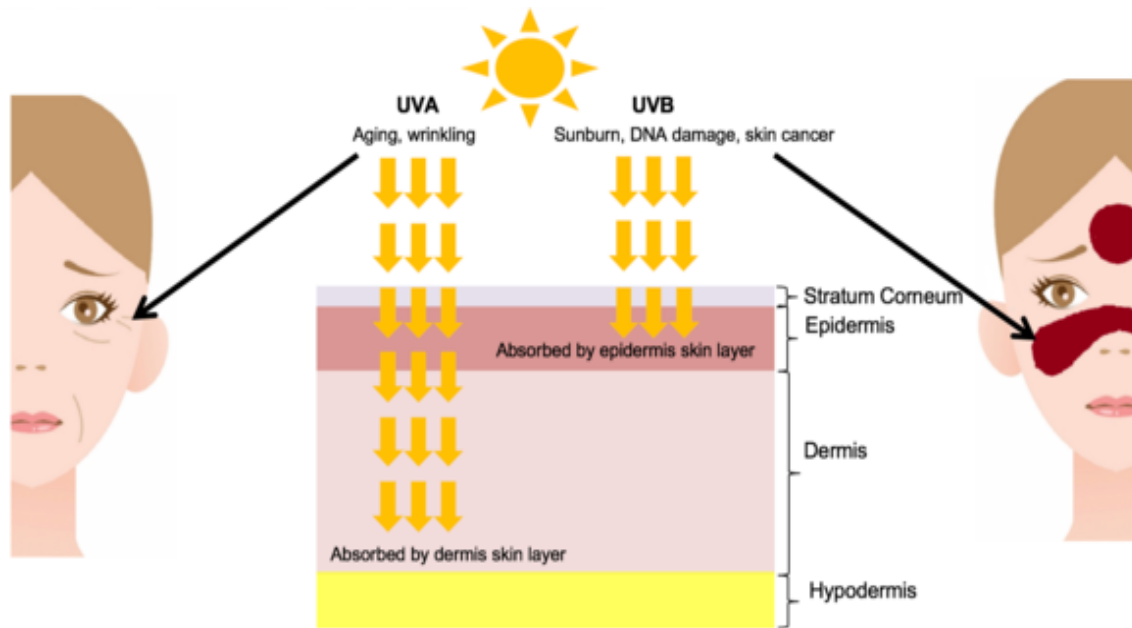


FIGURE (3) TYPES OF ULTRAVIOLET RADIATION WHICH PENETRATE SKIN LAYER

UVC RAYS

Ultraviolet C (UVC) rays have the shortest wavelengths and highest energy levels of the three types of UV rays. As a result, they can cause serious damage to all life forms. Fortunately, UVC radiation is completely filtered out by the ozone layer. As a result, these rays from the sun never reach the ground. Man-made sources of UVC include welding torches, special bacteria-killing light bulbs, and mercury lamps. Although not considered a risk for skin cancer, UVC rays can cause severe damage to human eyes and skin, including burns, lesions, and ulcers on the skin .[22]

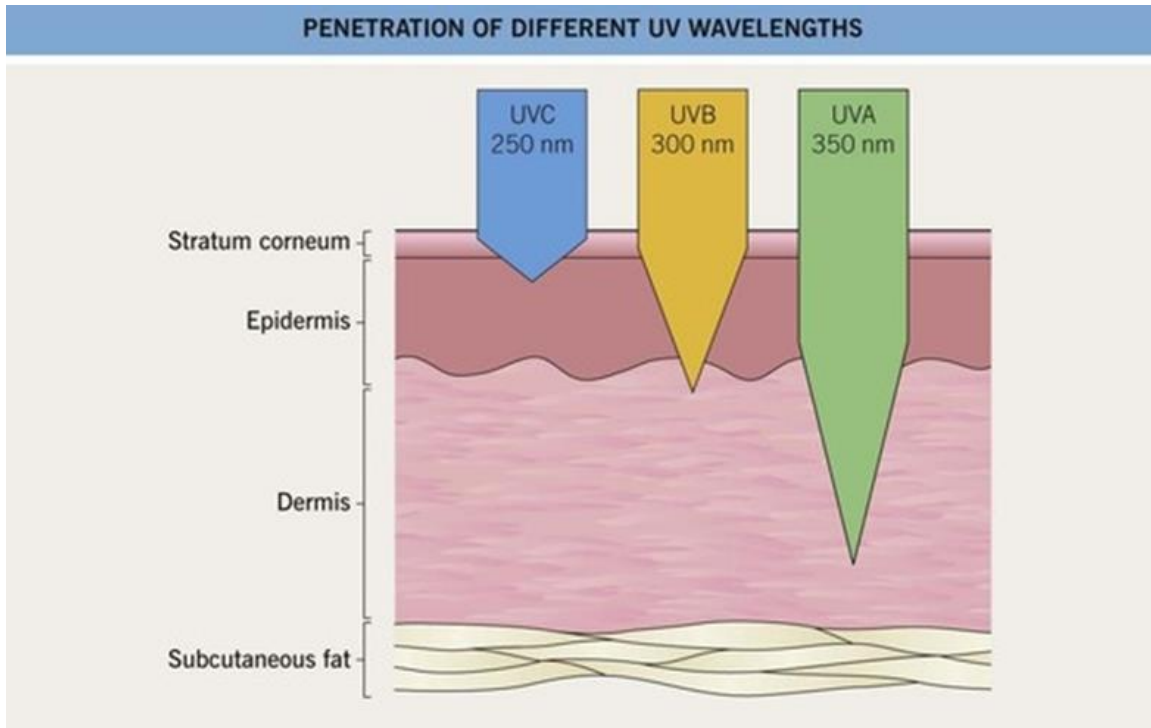


FIGURE (4) PENETRATION OF DIFFERENT UV WAVELENGTHS

BENEFICIAL EFFECTS OF UV RADIATION

include the production of vitamin D, a vitamin essential to human health. Vitamin D helps the body absorb calcium and phosphorus from food and assists bone development. The World Health Organization recommends 5 to 15 minutes of sun exposure 2 to 3 times a week.[26]

RISKS OF UV LIGHT

Sunburn is a sign of short-term over exposure, while premature aging and skin cancer are side effects of prolonged UV exposure. UV exposure increases the risk of potentially blinding eye diseases, if eye protection is not used. Over exposure to UV radiation can lead to serious health issues, including cancer. Skin cancer is the most common cancer in the United States. The two most common types of skin cancer are basal cell cancer and squamous cell cancer. Typically, they form on the head, face, neck, hands, and arms because these body parts are the most exposed to UV radiation. Most cases of melanoma, the deadliest kind of skin cancer, are caused by exposure to UV radiation. [26]

THE MECHANISM OF DNA DAMAGE BY UV RADIATION

DIRECT DNA DAMAGE

When UVB light hits the DNA strand, it causes a change in the structure of the chain. Any place along the strand that has two thymine bases in a row is vulnerable to this damage. The energy of the UVB light alters a chemical bond in the thymine. The altered bond causes the neighboring thymine bases to stick to each other. This pair of stuck-together thymine molecules is called a dimer. Wherever these dimers are formed, the DNA strand is bent from its normal shape, and cannot be read properly by the cell. Every second a cell is exposed to the UVB in sunlight can cause the creation of up to 100 dimers. If a cell accumulates too many dimers, it can die or become cancerous .[23]

INDIRECT DNA DAMAGE

UVA is not energetic enough to damage or alter DNA directly. It may help cause the formation of harmful oxygen radicals, however. Oxygen radicals can attack DNA directly, but can also alter fats and proteins in a way that makes them harmful to DNA. This damage is thought to be cancer-causing. The UVA used in indoor tanning booths and beds causes this type of damage, and increases the risk of skin cancer. UVA damage is cumulative, so more tanning means more risk. People who use indoor tanning are 75 percent more likely to develop skin cancer than those who do not. Unlike direct DNA damage, which occurs in areas directly exposed to UV-B light, reactive chemical species can travel through the body and affect other areas—possibly even inner organs. The traveling nature of the indirect DNA damage can be seen in the fact that the malignant melanoma can occur in places that are not directly illuminated by the sun—in contrast to basal-cell carcinoma and squamous cell carcinoma, which appear only on directly illuminated locations on the body .[23]

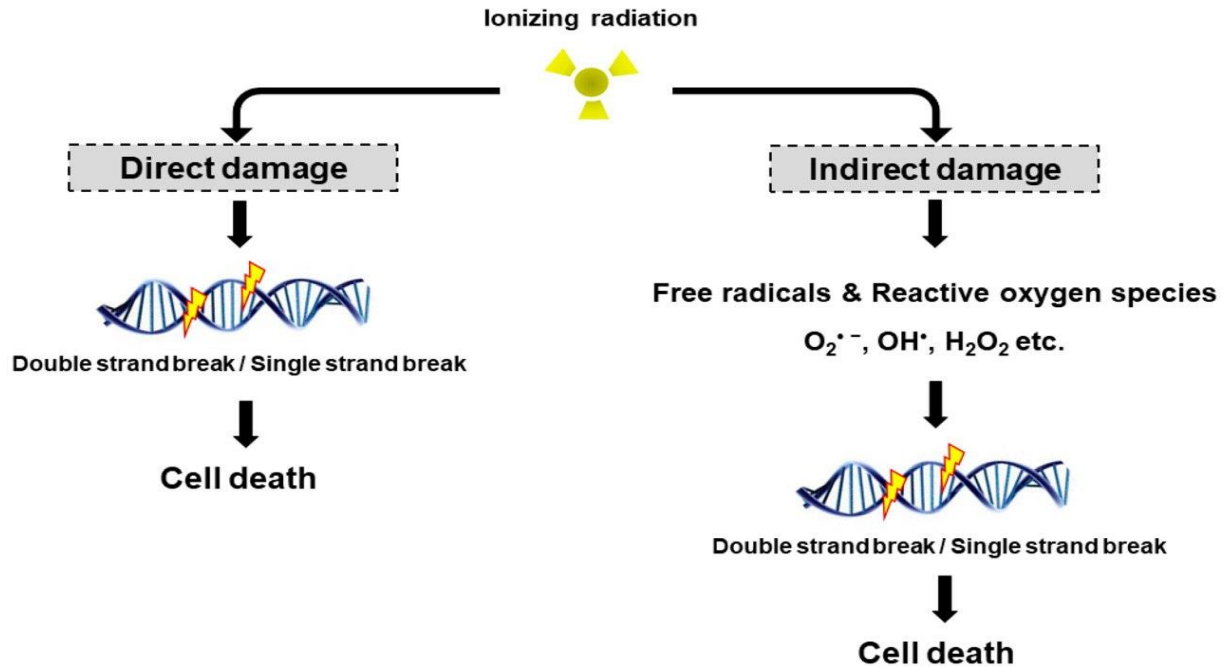


FIGURE (5) DIRECT AND INDIRECT DNA DAMAGE

TYPES OF SUNSCREEN PRODUCTS

The two most common types of sunscreen are **chemical sunscreen** and **physical sunscreen**. Physical sunscreens create a barrier on the skin that filter out UV rays, while chemical sunscreens absorb and scatter the sun's harsh UV rays. [24]

PHYSICAL SUNSCREEN

Physical sunscreens protect the skin in exactly the way their name suggests: they create a physical barrier between your skin and the sun. These products don't absorb into the skin but remain on the surface. Physical sunscreens are naturally broadspectrum, protecting against both UVA and UVB rays. [24]

CHEMICAL SUNSCREEN

Unlike physical versions, chemical sunscreens actually penetrate the epidermis and dermis. These chemical compounds function within the skin as well as on the surface to absorb the skin's rays before they can penetrate the dermis and cause damage. Chemical sunscreens such as avobenzone and homosalate essentially soak up UVA and UVB rays like a sponge. But a single chemical is generally not enough to protect against both types of harmful rays. Compound formulas are more likely to provide effective broad-spectrum protection. {16}*



Figure (6) physical and chemical Sunscreen products component.

NATURAL SUN BLOCKERS



The skin's natural sun blockers are proteins (the peptide bonds), absorbing lipids, and nucleotides. The high concentration of plant peptides protects the peptide bonds of the skin proteins. The high level of squalane (from olive oil) in some products protects the skin's sensitive lipids. Squalene is the skin's most important protective lipid. Allantoin is a nucleotide that naturally occurs in the body and absorbs the spectrum of UV radiation which damages the cell's fragile DNA. Allantoin is an extract of the comfrey plant and is used for its healing. The main destroying factors for skin are oxygenated molecules which are often called "free radicals." To stimulate the skin to repair and build itself naturally, we need an arsenal of potent ingredients. The "antioxidant power" of a food is an expression of its capability both to defend the human organism from the action of the free radicals and to prevent degenerative disorders deriving from persistent oxidative.

HERBAL COSMETICS

Calendula officinalis

Marigold flowers of *Calendula officinalis* contain flavonoid (Apigenin) , Apigenin was found to be effective in the prevention of UVA/UVB-induced skin carcinogenesis and demonstrated anti-inflammatory activity



Cosmetic and sunblock products : Life Basics

Silybum marianum

Silymarin is a flavonoid compound found in the seeds of milk thistle (*Silybum marianum*) [2]. Silymarin consists of the following three phytochemicals :silybin, silidianin ,andsilicristin. Silybinisthemostactive phytochemical.[3] Topical silymarin has been shown to have are markable antitumor effect. Silymarin reduced UV-induced sunburn cell formation and apoptosis. Silymarin treatment prevents UVB-induced immune suppression and oxidative stress in vivo.



Cosmetic and sunblock products : BANOBAGI

Curcuma longa

Curcumin (diferuloylmethane) is a yellow odorless pigment isolated from the rhizome of turmeric. Curcumin possesses anti-inflammatory, antitumoral, and antioxidant properties. It inhibits UVA-induced ornithine decarboxylase (ODC) activity and scavenges reactive oxygen species (ROS).[5].



Cosmetic and sunblock products : VIVAIODAYS

Vitis vinifera

Grape seed of *Vitis vinifera* contains Proanthocyanidin (OPC). OPC works as a DNA mutation inhibitor. Also, OPC blocks elastase, maintaining the integrity of elastin in the skin and acts synergistically with both vitamin C and E, protecting and replenishing them.[6]. The grape OPCs synergistically interacted with vitamin E, recycling the inactivated form of the vitamin into the active form and thus acting as a virtual vitamin E extender. Grape seed proanthocyanidins (GSP) are potent antioxidants and free radical scavengers.



Cosmetic and sun block products : pure shade

Polygonum cuspidatum

The roots of the weed *Polygonum cuspidatum* constitute one of the richest sources of resveratrol. Resveratrol is fat-soluble compound belongs to a class of polyphenolic compounds. Resveratrol was found to act as an antioxidant and antimutagen. Long-term studies have demonstrated that 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.[7]



Cosmetic and sun block products : Andalou Naturals

Fragaria ananassa

Red strawberry fruit that extract from *Fragaria ananassa* contain anthocyanin pelargonidin that protects the amino acid tyrosine from the highly reactive oxidant peroxynitrite.[8] also has anti inflammatory effect.



Cosmetic and sun block products : Carmex Daily Care Tube SPF15 – Strawberry

Dacus carota

Carrot is one of the most important root vegetable plants in the world. Carrot contain β carotene that protects the skin from UVB radiation as it is full of antioxidants. Antioxidants neutralize the free radical activity that occurs as a result of sun exposure, making them an invaluable part of any skin-protection product. .[9]



Cosmetic and sunblock products : Biotique

Solanum lycopersicum

Tomatoes basically contains carotene lycopene, which is most powerful natural antioxidant and natural pigment that makes them red and has also been linked to a reduction in DNA damage from UV exposure. Lycopene has also been shown to improve the skins ability to protect against harmful U.V rays.[10-11].



Cosmetic and sunblock products : *Tomato sun cream*

Sambucus nigra

The fruit of *Sambucus nigra* (elderberries) contains anthocyanins cyanidin-3-glucoside, cyanidinactas antioxidant,[12] protect cell membrane lipids from oxidation [13] and neutralize enzymes that destroy connective tissue, anti-inflammatory ,repair damaged proteins.



Cosmetic and sunblock products:SIMPLICITE

Ginkgo Biloba

Quercetin, is a flavonoid in *Ginkgo biloba* leaf extract that is partly responsible for many of its medicinal properties. it protects from free-radical damage and is an anti-inflammatory. It increases circulation and regenerates the skins surface.it found to provide protection in the UVA and UVB range,prevention of UVC radiation-induced liposome peroxidation and SPF of quercetin matches to homosalate, a synthetic sunscreen agent. .[14]



Cosmetic and sun block products : alba

Camellia sinensis

the main active ingredient in green tea, epigallocatechin-3-gallate (EGCG), works well as an anti-inflammatory, antioxidant, and sunscreen. 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. Green tea was also found to decrease melanoma cell formation with topical and oral administration in mice. .[15]



Cosmetic and sun block products : Eco

Aloebarbadensis

The leaves of *Aloe barbadensis* contain polysaccharides, mannose-6-phosphate, and complex anthraquinones all contribute synergistically to the benefits of this material. It has been demonstrated that it has a prophylactic effect if used before, during, and after these skin damaging (all forms of burn). Clearly, the plant is mainly used for its soothing and cooling effect; however, the plant is useless if used at less than 50% and it is recommended that it is used at 100% to be sure of any beneficial effect. Aloe vera not only improved fibroblast cell structure, but also accelerated the collagen production process. Aloe vera is a uniquely effective moisturizer and healing agent for the skin. [16].



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Cosmetic and sun block products : aloe vera

Helianthus annuus

Sunflower seed oil contains beta-carotene, a compound that can be converted into vitamin A, which has antioxidant properties. Like carrot oil, it is replete with vitamin E, which is renowned for its function as an antioxidant as well as being a natural preservative, ideal for skin healing. The flowers of *Helianthus annuus* contain quercetin that has anti-inflammatory and antioxidant activity. HAF extract significantly blocked UVB- induced ROS and MMP (MMP- 1 and MMP- 3) production and procollagen type I reduction. .[17]



Cosmetic and sunblock products : Innisfree

Triticum aestivum

Wheat germ oil extracted from the germ of the wheat kernel, this oil is highly rich in fatty acid linoleic acid (omega-6). wheat germ oil packed with vitamins E, K, and B. It neutralizes free radicals and protects the skin from UVB rays, while adding a moisturizing effect for optimal skin health.



Cosmetic and sunblock products :GIVERNY

Krameria triandra

The antioxidant photoprotective potential of a standardized Krameria triandra root extract (15% neolignans) has been evaluated in different cell models, and human keratinocytes cell lines, exposed to chemical and physical (UVB radiation) free radical inducers. potential use of Rhatany extracts, standardized in neolignans, as topical antioxidants/radical scavengers against skin photodamage [19].



Cosmetic and sunblock products:LATANIA ATO

Persea americana

High-quality, natural suntan and after-sun products are found in abundance at natural food stores. Avocado (*Persea americana*) oil is rich in vitamin E, β – carotene, vitamin D, protein, lecithin, and fatty acids and offers considerable benefits when added to preparations. From avocado oil to botanicals such as rosemary and comfrey, these ingredients soothe and protect the skin. [20]



Cosmetic and sunblock products :VAADI

Eucalyptus globulus

Eucalyptus leaves are a great source of antioxidants, particularly flavonoids, which protect your body from oxidative stress and free radical damage . also,has essential oils in leaves which make the extract to absorb more UV light than the other plants.extract of Eucalyptus has a high sun protection effect. This extract can be used as additives in other sunscreen formulations to enhance their SPF.[21]



Cosmetic and sunblock products: ART SHAVING

CONCLUSION

UV radiation cause skin damages. Everybody needs protection from harmful UV lights. There are many different ways to protect our skin. The best way is avoiding direct sun exposure. But sometimes, it can be impossible, especially during summer. Because of that, sunscreen products should be used. Using natural ingredients in different skin care products is very popular today. Plants' ability to protect themselves from UV radiation from the sun is the main reason for that. Plants have a good potential to help us. Plant phenolics are one candidate for prevention of harmful effects of UV radiation on the skin. Additionally, plants contain a lot of other substances which can be useful for skin care. Their potential is still undefined. Nevertheless, more research trials and clinical evidences are needed. {17}*

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