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Review Article

MEDICINAL PLANTS USED IN SKIN PROTECTION

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ABSTRACT

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. Although isolated plant compounds have a high potential in protection of the skin, whole herbs extracts showed better potential due to their complex composition. 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. Many studies showed that green and black tea (polyphenols) ameliorate adverse skin reactions following UV exposure.

Keywords: Antioxidants, cosmetics, plant extract, sun blocks, Ultra violet radiation

INTRODUCTION

Sunscreen products are very popular on markets last years. But, the reason for their production is different now. In the beginning, people wanted to get beautiful sun tan easily and fast, without the risk to get burns. Nowadays, it is necessary for all people to use sunscreen products because of protection against ultraviolet (UV) radiation. This review covers all essential aspects of potential of herbs as radio protective agents and its future prospects.

Ultraviolet radiation

Electromagnetic radiation is broadly divided into infrared radiation (IR), visible light (VIS), and UV radiation. Heat is part of IR radiation, which is not visible to the human eye. VIS is the wavelength range of general illumination. UV radiation is divided into three distinct bands in order of decreasing wavelength and increasing energy: UVA (320-400 nm), UVB (290-320 nm), and UVC (200-290 nm). Different wavelengths and energy associated with UV subdivision correspond to distinctly different effects on living tissue.[1]

Damaging effects of ultraviolet radiation

Acute response of human skin to UVB irradiation includes erythema, edema, and pigment darkening followed by delayed tanning, thickening of the epidermis and dermis, and synthesis of vitamin D; chronic UVB effects are photo aging, immunosuppression, and photocarcinogenesis.[3,4] UVB-induced erythema occurs approximately 4 hours after exposure, peaks around 8 to 24 hours, and fades over a day or so; in fair-skinned and older individuals, UVB erythema may be persistent, sometimes lasting for weeks.[5] The effectiveness of UV to induce erythema declines rapidly with longer wavelength; to produce the same erythemal response, approximately 1 000 times more UVA dose is needed compared with UVB.[6,7] The time courses for UVA-induced erythema and tanning are biphasic. Erythema is often evidenced immediately at the end of the irradiation period[8] it fades in several hours, followed by a delayed erythema starting at 6 hours and reaching its peak at 24 hours. The action spectrum for UV-induced tanning and erythema are almost identical; however, UVA is more efficient in inducing tanning, whereas UVB is more efficient in inducing erythema.[9,10]Skin care products for UV protection should be used to reduce harmful effects of UV radiation and/or suppress them totally. Therefore, UV protection becomes a major function of more types of cosmetic formulations.

Sunscreen products

There are a lot of different types of sunscreen products (oils, sticks, gels, creams, lotions) which can be found on the world's market. All of them must have sunscreens that provide adequate protection from harmful UV rays (UVA and UVB).There are two general types of sunscreens—chemical and physical. A chemical sunscreen absorbs the UV rays, while the physical sunscreen reflects the harmful rays away from the skin like a temporary coat of armor.[12]

Chemical sunblocks

Most chemicals only block narrow region of the UV spectrum. Therefore, most chemical sunblocks are composed of several chemicals with each one blocking a different region of UV light. Mostly, chemicals used in sunblocks are active in UVB region. Only a few chemicals block the UVA region. The best sunblock is the sunblock that combine both chemical and physical active ingredients. Dermatologists routinely recommend sunblocks that contain either a physical blocking agent or avobenzone (Parsol®1789) in combination with other chemicals. However, in the USA, combinations of avobenzone and physical sunscreens are not permitted. Avobenzone has been reported to be unstable when contained in formulations with physical sunscreens. Surface coating of pigment has sometimes been shown to increase its stability.[13]]Whitening is unacceptable in beach and skin care products with sun protection factor (SPF). It is difficult to create elegant formulations useful to protect against harmful UVA/B rays. Now, broad-spectrum protection in foundations is achievable using titanium dioxide with greater scattering power and iron oxides.[11] Many of the organic chemicals commonly used in sunscreen products have not been established safe for long-term human use. For example, titanium dioxide- and zinc oxide-based sunscreens are being promoted on the basis that they may be less harmful than organic sunscreen absorbers. But, the use of microfine titanium dioxide as a sunscreen product also has no long-term safety data.[14] Today, manufacturers use a lot of different natural components for skin protection from UV radiation. These products contain a high level of natural UV absorbers such as squalane, peptides, and nucleotides that have been protecting mammalian skin for over 100 million years.[15]

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, soothing, and anti-irritating properties. This extract can be found in antiacne products, sun care products, and clarifying lotions because of its ability to help heal minor wounds and promote healthy skin.[18] Some clinical studies confirm that allantoin enhance skin repair.[15]

Natural sources of antioxidants

The main destroying factors for skin are oxygenated molecules which are often call "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 stress.[19] Plants like olive trees have their own built-in protection against the oxidative damage of the sun, and these built-in protectors function as cell protectors in our own body. The very pigments that make blueberries blue and raspberries red protect those berries from oxidative damage.[20]

Proanthocyanidin

Proanthocyanidin (OPC) works as a DNA mutation inhibitor. Also, OPC block elastase, maintaining the integrity of elastin in the skin and act synergistically with both vitamin C and E, protect and replenish them.[21] OPC in cream form has been researched and demonstrated to be effective against the dangerous effects of the sun (UV rays). When OPC cream is applied to the skin before exposure to the sun, less burning of the skin occurs.[22] In one study, grape seed OPCs exerted a solo antioxidant effect at a level of potency on a par with vitamin E-protecting different polyunsaturated fatty acids from UV light-induced lipid peroxidation. In this same study, 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.[23] Grape seed proanthocyanidins (GSP) are potent antioxidants and free radical scavengers. GSP inhibited skin tumor formation and decreased the size of skin tumors in hairless mice exposed to carcinogenic UV radiation. Exposure to UV radiation can suppress the immune system, but GSP prevented this suppression in mice fed a diet containing GSP. Treatment of cells with GSP increased tumor cell death in a model used to study tumor promotion in skin cells.

Quercetin

The most common flavonol in the diet is quercetin.[25] Quercetin has anti-inflammatory and antioxidant effects and act as a immunomodulator.[26] A diet rich in quercetin has been reported to inhibit the development of carcinogen-induced rat mammary cancer,[27] colonic neoplasia,[28] oral carcinogenesis,[29] and skin tumor formation in three models of skin carcinogenesis in mice when administered by topical application.[30] Quercetin may account for the beneficial effects of dietary fruits and vegetables Table 1] on mutagens and carcinogens, including metals.[31] It is present in various common fruit and vegetables, beverages, and herbs.[32] The highest concentrations are found in onion.[25] Quercetin and rutin were tested as potential topical sunscreen factors in human beings and found to provide protection in the UVA and UVB range.[33]

Apigenin

Apigenin is a widely distributed plant flavonoid occurring in herbs, fruit, vegetables, and beverages. Apigenin was found to be effective in the prevention of UVA/UVB-induced skin carcinogenesis in SKH-1 mice.[32] Apigenin did not inhibit nuclear translocation of NF-κB, but did inhibit reporter gene expression driven by NF-κB.[34] Apigenin is also found in marigold (*Calendula officinalis*), where it was shown, using the mouse ear test, that the flavonoids were responsible for the activity and, of these, apigenin was more active than indomethacin in the test. Artemisia (*Artemisia inculta*) and *Cuminum cyminum* or cumin also contain apigenin and luteolin and their derivatives in addition to plants like carrot (*Daucus carota*), agrimony (*Agrimonia eupatoria*), arnica (*Arnica montana*), purple coneflower (*Echinacea purpurea*), and eyebright (*Euphrasia officinalis*)—all of which have demonstrated anti-inflammatory activity when used under the right conditions.35]

Silymarin

Silymarin is a flavonoid compound found in the seeds of milk thistle (*Silybum marianum*)[63]. Silymarin consists of the following three phytochemicals: silybin, silidianin, and silicristin. Silybin is the most active phytochemical.[24] Topical silymarin has been shown to have a remarkable antitumor effect. The number of tumors induced in the skin of hairless mice by UVB light was reduced by 92%. Silymarin reduced UV-induced sunburn cell formation and apoptosis. The result was not related to a sunscreen effect and an antioxidant mechanism may be responsible.[35] Silymarin treatment prevents UVB-induced immune suppression and oxidative stress *in vivo*.[37]

Carotenoids

Dietary 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, in some cases up to an SPF of 5, and may reduce the UV-induced inflammatory response by a lowered prostaglandin E2 levels (a mediator in the arachidonic acid cascade for inflammation). In human fibroblasts, lycopene, β-carotene, and lutein were all capable of significantly reducing lipid peroxidation caused by UVB. One clinical study reported significant improvements in skin thickness, density, roughness, and scaling after 12-week oral supplementation with lycopene, lutein, β-carotene, α-tocopherol, and selenium. Another human trial with oral administration of lycopene β-carotene, α-tocopherol, and selenium reported decreased UV-induced erythema, lipid peroxidation, and sunburn cell formation.[38] Oil extracted from the fruits and pulp of *Hippophae rhamnoides* (sea buckthorn) has long been used in skin care in Turkey, China, and Russia and represents interesting possibilities for future research in antiaging formulations.[56] It contains high levels of linoleic (30 – 40%) and α–linolenic (23 – 36%) acids.[56]

Herbal extracts in use

Whole herbal extracts consist of numerous compounds that together provide better effects on the skin. One herbal extract may show antioxidant, anti-inflammatory, emollient, melanin-inhibiting, antimutagenic, antiaging properties, etc.

Aloe vera

The reputable *Aloe vera* or *Aloe barbadensis* has been scientifically proven for all forms of burn, be it radiation, thermal, or solar. It has also been demonstrated that it has a prophylactic effect if used before, during, and after these skin damaging events. 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. The polysaccharides, mannose-6-phosphate, and complex anthraquinones all contribute synergistically to the benefits of this material.[17] The natural chemical constituents of *Aloe vera* can be categorized in the following main areas: Amino acids, anthraquinones, enzymes, lignin, minerals, mono- and polysaccharides, salicylic acid, saponins, sterols, and vitamins. *Aloe vera* not only improved fibroblast cell structure, but also accelerated the collagen production process.

Walnut

Walnut extract is made from the fresh green shells of English walnut, *Juglans regia*. The aqueous extract has been shown to be particularly effective as a self-tanning sunscreen agent. Its most important component is juglone (5-hydroxy-1,4- naphthoquinone), a naphthol closely related to lawsone (2-hydroxy-1,4- naphthoquinone). Juglone is known to react with the keratin proteins present in the skin to form sclerojuglonic compounds. These are colored and have UV protection properties[39]

Plant oils as sunscreens

Researchers have found that some plant oils contain natural sunscreens. For example, sesame oil resists 30% of UV rays, whereas coconut, peanut, olive, and cottonseed oils block out about 20%. Although mineral oil does not resist any UV rays, it helps to protect skin by dissolving the sebum secreted from oil glands, thus assisting evaporation from the skin.

Borage oil

Borage (*Borago officinalis*) oil stimulates skin cell activity and encourages skin regeneration. It contains high levels of gamma-

linoleic acid (GLA), making it useful in treating all skin disorders, particularly allergies, dermatitis, inflammation, and irritation. Borage penetrates the skin easily and benefits all types of skin, particularly dry, dehydrated, mature, or prematurely aging skin[41].

Evening primrose oil

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[41].

Porphyra

Porphyra (*Bangiales, Rhodophyta*), delicious red algae widely consumed in eastern Asia, contains high levels of free amino acids; when exposed to intense radiations, it synthesizes UV-absorbing secondary metabolites such as mycosporine-like amino acids. There are almost seven species of *Porphyra* identified in India. Among all of these, nowadays *Porphyra vietnamensis* are gaining more attention. Marketed *Aloe vera* gel had low absorption power over broad UV wavelength (250-400 nm) as compared with isolated compound gel, suggesting that Porphyra-334 is more potent.[2]

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. Consumers request high-quality products with accessible prizes. It means that they want to get everything when they apply these products. All in one: Protection skin from UV radiation, antiaging and wrinkles reduction, moisturizing and cooling effects on the skin without allergic reaction, and coloring effects on the skin. This request is the main guide for scientists and researchers. Also, they know that chemical components sometimes have harmful effects on the skin. Because of that, they more and more choose products with natural components. 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. It was shown that using only one natural component is not enough for skin protection. Maybe, combination of several different natural substances is a right solution. It will be ideal to make the product with natural components only, without any harmful effects. Also, it is necessary to find out in which form this combination is stable and has the best effects. There are many products with natural ingredients that are available in the world's market. But, there is no product which can accomplish all requests of consumers. This is the main direction for new product development.

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