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A Review On Benefits of Herbal Ingredients used in Sunscreen.

Morupoju Sushma[1*], K.V. Ratnamala[1].
1.Department of Pharmaceutics, RBVRR Women College of Pharmacy. Narayanguda, Hyderabad-500027, Telangana, India.

ABSTRACT

The present review focuses about the benefits of herbal ingredients in the formulation of sunscreen. Sunscreens are called as sunburn or sun blocker creams. Sunscreen function is to protect the skin from damaging effects caused by solar UV radiations. They aid [synergies with] the body's natural defense mechanisms against solar UV radiations. Its function is based on their ability to absorb, reflect or scatter the rays from sun. Herbal cosmetics are known as the products which acts as beautifying agent as well as have physiological functions like healing, soothing, conditioning, appearance and enhancing characters because of the presence of herbal ingredients." There is a proof from regulatory authorities that the synthetic sunscreens are more effective towards UV related problems but they have their own potential risk. So, its beneficial and safe to use herbal ingredient in the sunscreen rather than synthetic ingredients. They are easier to incorporate in the sunscreen formulation and do not induce any side effects or provoke the allergic reactions. They are eco-friendly, effective & have good purity, stability, safety, cost effective and easily found in large variety of plants. Hence in this current review an attempt was made to study sunblocking agents which have antioxidant property, that prevent penetration of UV radiation and hence inhibits free radical production.

Keywords: Ultravoilet radiation [UVR], Ultravoilet radiation-A [UVA], Ultravoilet radiation-B [UVB], Ultravoilet radiation-C [UVC], antioxidant, SPF [sun protection factor].

*Corresponding Author Email: sushma.morupoju@gmail.com
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INTRODUCTION

Ultavoilet radiation [UVR] is known as that part of the electromagnetic spectrum between X rays and visible rays. It ranges from 40 – 400nm. UVR [sunlight & artificial light] is subdivided into sections, they are- UVA (400-320nm) [UVA 1(longer wavelength 400-340nm) UVA 2 (shorter wavelength 340-320nm)], UVB (320-290nm), UVC (<290nm). UVR from the sun comprises approximately 95-98% UVA and 2-5% UVB at the earth's surface. If the wavelength is longer their will be deeper the UV penetration into the skin and shorter the wavelength, the greater the energy level of the light and more the damage it causes. **UVA rays** which are not absorbed by the ozone layer, they penetrate deep into the skin and leads to premature aging. Upto 90% of visible changes on skin commonly are caused by UVA. **UVB rays** are very powerful rays, which are partially absorbed by ozone layer, mostly affect the skin surface and are the initial cause of sunburn. Because of thinning of ozone layer, the effects of UVB radiation will pose an increased threat. UVA reaching to earth's surface roughly considered as 10-20 times greater than that of UVB. UVC rays is highly responsible in cause of sunburn and could destroy the skin but it is completely absorbed by stratospheric ozone[1].

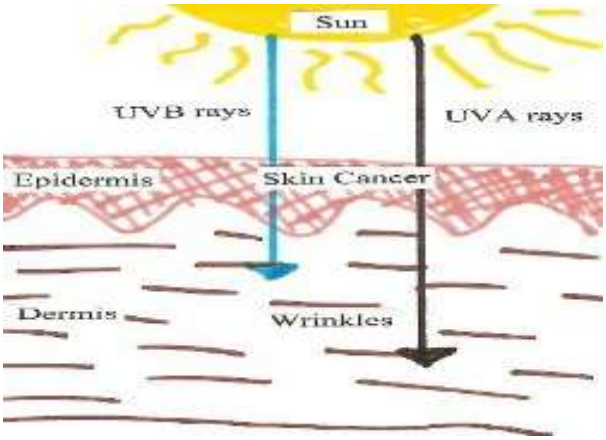

Figure: 1[2] Various UV-rays.

SKIN EFFECTS CAUSED BY UVR:

UVB is the principle cause for tanning and acute sunburn and also being immunosuppressive, carcinogenic and mutagenic. Meanwhile, the importance of the UVA biologically has been recognized. UVA causes significant photo biological reactions, mostly of indirect to the nature and requires oxygen such as delayed and immediate tanning reactions and formation of new melanin. There is now considerable required evidence that UVA contributes to skin's longterm degenerative changes, such as significant connective premature skin aging and cancer formation and may also contribute to carcinogenesis which is induced by UVB. Apart from thatUVA and UVB

plays a significant role in the pathogenesis of photosensitive diseases[1].

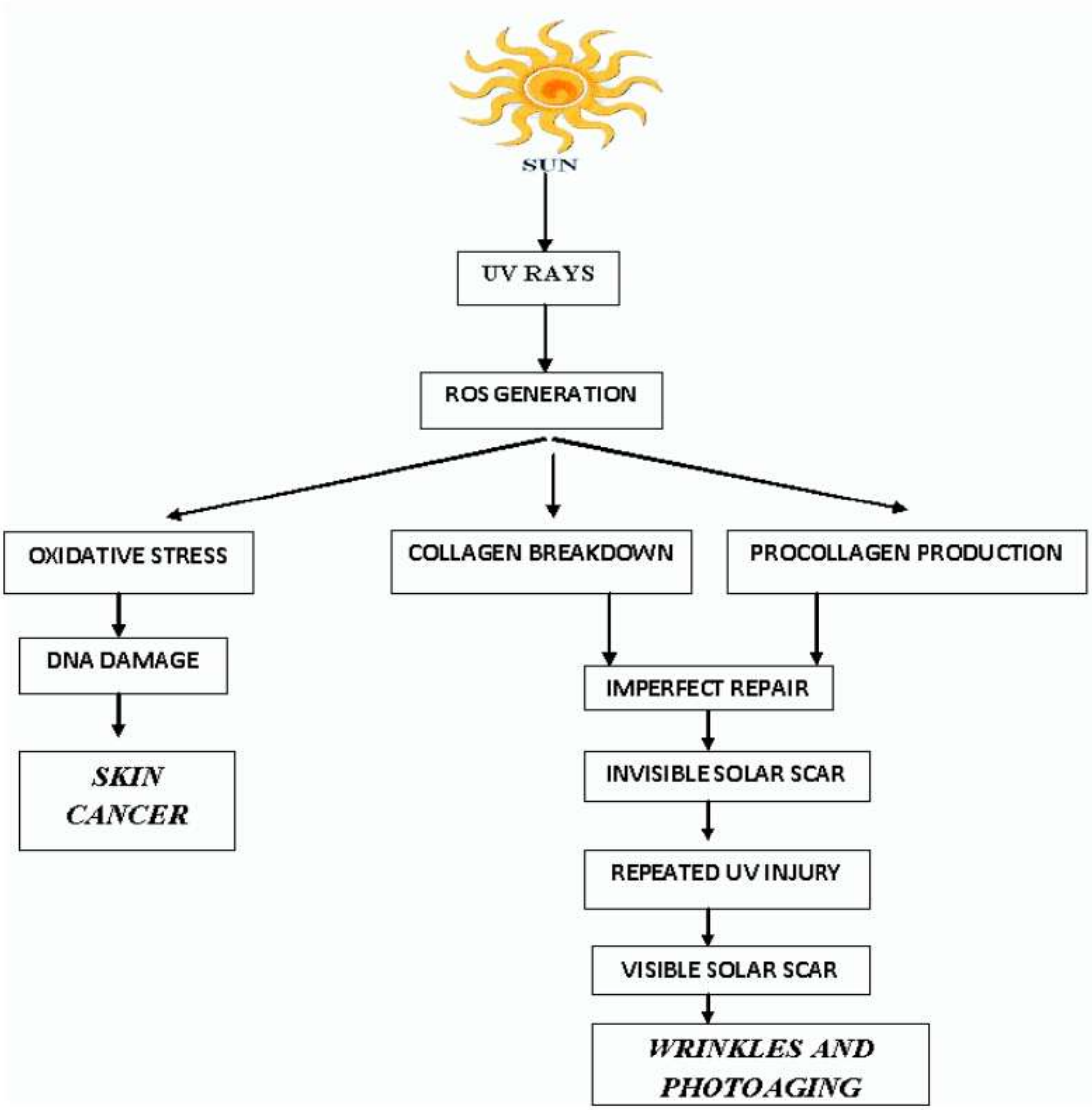

Figure 2: Effect of ROS on Skin

Reactive oxygen species (**ROS**) are chemically reactive species which contains oxygen. Eg - include peroxides, superoxide, radical, and singlet oxygen. ROS are natural byproduct of normal metabolism of oxygen and have major roles in cell homeostasis and signaling. However, during environmental stress (e.g., UV or heat exposure), ROS levels may increase drastically. This may result in severe damage to cell structures.

CAPACITY OF HUMAN'S TOWARDS SUNPROTECTION:

Upon exposure to ultravoilet radiation skin gets stimulated and increases the skin's self-protection mechanism to 2-fold. Firstly, the swelling of epidermis which is caused by UVB radiation increases the protection by 3 to 4 folds. Secondly, increase in melanin synthesis (tanning) caused by UVA and UVB radiation, gives the skin 2-3 folds more protection.

SUNSCREEN:

Sunscreens are called as sunburn or sunblocker creams. It is topically used product. Its usage became popular day to day against UV radiations. Since, sunscreen function is to protect the skin from damaging effects caused by solar UV radiations. They support the body's natural defense mechanisms against suns UV radiations. Based on its mechanism of action, sunscreens are divided into 2 types, they are-Physical &Chemical sunscreens[2].

The sun protection factor (SPF) is an important characteristic of sunscreen which is calculated by comparing the time needed to cause sunburn on sunscreen protected skin to time needed to produce sunburn on unprotected skin. Higher SPF containing sunscreens show greater protection against sunburns. SPF action is determined by applying the product on skin in significant amounts (2mg/cm2 of the skin).

POSSIBLE HERBAL INGREDIENTS IN SUNSCREEN:

There is a proof from regulatory authorities that the synthetic sunscreens are more effective towards UV related problems but they have their own potential risks. For example-a) Results from CDC (center for disease control and prevention) occurred in 2007 has reported that the mothers having high amount of *oxybenzone* in their system [body] were more possibly to give birth to underweight babies. b) Based TGA (therapeutic goods administration) study there is a proof that, presence of *titaniumoxide* and *zinc oxide* will cause more free radical production which leads to damage of normal cell (photomutagenesis)[2]. So, its beneficial & safe to use *herbal ingredient* in the sunscreen rather than synthetic ingredients.

IDEAL CHARACTERISTICS OF HERBAL AGENT:

1. Absorb light over the range of 280-320nm.
2. Be non-toxic and non-irritant.
3. Be stable to light, heat, and perspiration.
4. Rapidly not absorbed.
5. Be neutral.
6. Rapidly soluble in suitable vehicle.

VARIOUS HERBAL INGREDIENTS USED IN SUNBLOCKERS/ SUNSCREEN:

Some of the natural substances for skin protection [6] are shown in table 1.

Table 1: Natural Substances for Skin Protection [6]

Active agent	Natural sources	Actions
Quercetin	Onion, tea, evening primrose, mayapple, neem, sunflower, cranbery, apple.	Antioxidant, Anti-inflammatory, Immunomodulator, Inhibits skin tumor formation, potential topical sunscreen.
Curcumin	Turmeric	Anti-tumor, reduce UV- induced sunburns, antioxidant.
Silymari	milk thistle	Anti-inflammatory, anti-tumor, anti-oxidant, Free radical scavanger.
Proanthocyanidin	Grape seeds, blackjack oak, horse chestnut, witch hazel, apples, berries, chocolate, barley, beans, hawthorn.	DNA mutation inhibitor, free radical scavanger, anti-oxidant.
Cyanidin	Apple, peach, pear, fig, red cabbage, gooseberry, cherry.	Protect cell membrane lipids from oxidation & neutralize enzymes that destroy connective tissue, anti-inflammatory, antioxidant.
Pelargonidin Anthocyanins	Strawberry, potato, red raddish, banana.	

Phyllanthus emblica (family-phyllanthaceae)

It is used mostly in Thai medicines for various diseases. This fruit contain high quantity of vit-C (ascorbic acid). It consists of minerals, amino acids, calcium, iron, carotenes & also have mixture of polyphenols such as flavonoids, phyllembin. Presence of above constituents shows free radical scavanger activity, prevents production of peroxide free radical, hence protects from uv radiations.

Green tea (Camellia sinensis family-Theaceae)

Leaves of these plant are popular nutraceutical used as antioxidant. Antioxidants protect the cells from lethal effects of ROS such as singlet oxygen, superoxide, hydroxyl radicals. These radicals are produced due to uv ray's penetration. Chemical constituents are Vit-E, tocopherols, catechins, polyphenols & carotenoids which shows antioxidant property so, it is used as herbal sunscreen agent.

Luffa cylindrica(family-cucumbitaceae)

It is a climber and have slender, slightly hairy stem along with little furrowing. Seeds of it contain oil in which fatty acids are linoleic acid, stearic acid [unsaturated fatty acid].This unsaturated fatty acid has free radical scavenging activity. The study done by Yoganandam et al concluded that the fixed oils isolated from the seed kernels not only involves in scavenging of free radicals but also inhibits their production.

Aloe vera

It is a succulent plant and comes under liliaceous family. Chemical constituents are amino acids, enzyme, polysaccharides, vitamins (A, E, C), stearic acid, oleic acid, anthraquinones. This plant mainly known for its cooling & soothing effect but it is ineffective when used in less than 50% & is very effective if used in 100% pure form. It has scientifically evident to treat all type of burns be it radiation or thermal & all wound healings also. It is mostly used as sunscreens, moisturizers, suntan agent & also acts immune enhancer due to its high levels of antioxidant [12].

Shea butter-

It have compounds known as cinnamic acid esters, which are also found in cinnamon and balsam trees. These compounds have powerful anti-inflammatory action that help instant soothening of skin swellings, inflammation and irritation as well as contain antibacterial properties and sun protection qualities. They fastly calm skin redness and helps to prevent from harmful UV radiations and premature-aging, which caused by free radicals' penetration into the skin."Cinnamate esters of triterpene alcohol which are the major constituent of Shea butter's unsaponifiable fraction are having strong absorbance of UV rays in the wavelength range at 250-300 nm, which leads to the addition of Shea butter's unsaponifiables in the sunscreens which provide synergistic sun-protection action by increasing the absorption of UVB rays."

Turmeric (curcuma longa, family-Zinziberaceae-

It is a rhizomatous plant its main constituents are curcuminoids which include demethoxycurcumin & curcumin, volatile oils like turmerone, zinziberene .Curcuminoids helps to prevent cell damage from free radicals, it is capable to scavenge the hydroxyl radical and it is more efficient among all antioxidants and protect from uv radiations[12].

Apple (Malus domestica, family-rosaceae)

Its peels are source for various phytochemicals which acts as antioxidant. Phytochemical are, epicatechin, quercetin & flavonoids. Due to above constituents it shows action against uv radiations which produce free radical.

Promegranate (Punica granatum family-Lythraceae)

Promegranate in Indian Ayurveda used extensively as source of traditional remedies for 1000 years. Its arils provide 16% daily value of vitamin K, 12% of vit-C. It consists of punicalgins, punicafolin, granatin A & B & flavonoids which show free radical scavenging activity. Punicalgin has antioxidant property.

Walnut (Juglans regia, family- Juglandaceae)

Its extract acts as self-tanning sunscreen agent. Its constituents are juglone, napthol. Juglone react with keratin which is present in skin and forms sclerojuglonic compounds which leads to tanning of skin and protect from uv rays.

Rose root (Rhodiola rosea, family-Crassulaceae)

This plant grows only in cold regions. Contains phenols, terpenoids, flavonoids, alkaloids, organic acids and others like phenolic antioxidant, chlorogenic acid, quercetin, gallic acid. Due to presence of above chemical constituents it provides ability to inhibit uv penetration.

Lemon (Citrus limonum, family-lythraceae)

lemon oil is produced from fruit, which has sharp, fresh smell, and it has water viscosity. Chemical constituents are camphene, nerol, neral, alpha & beta pinene and ascorbic acid which have antioxidant property. It has emollient action on sunburnt skin cell and exfoliate the skin.

Tomato (solanum lycopersicum, family-Solanaceae)

They are available easily all over the world. It contains carotene, lycopene which are powerful antioxidants. Lycopene also protect skin from harmful uv rays. Tomatos also contain anthocyanin, vitamin A, C, E, due these above constituents tomatoes will acts as neurodegenerative diseases, inhibits the uv ray's penetration. And they are proved to be used as natural sunscreen ingredient.

Carrot (dacus carota, family-apiaceae)

Carrot is a root vegetable. It contains beta carotene which inhibits the free radical production. Other constituents are carrot seed oil, vit A, stigma sterol, which actively enhance body's immune response against uv radiation[12].

Major oils used as sunscreens:

Sesame oil (Sesamum indicum, family-pedaliaceae

It is called as healing oil in the past 1000 years. It shows potent antioxidant property. This oil after application beneath the skin it acts to neutralizes the free oxygen radicals. It is a rich source of vitamin A, sesamin, sesamol and helps to restore the moisture & softens the skin.

Sunflower oil (helianthus annus)

It is a non-volatile oil produced by compressing seeds. Basically, it contains omega 9& 6, MUFA, PUFA, vitamin E also contain tocoferol, lecithin, waxes. It helps to retains moisture in skin and inhibits penetration of uv radiations.

Castor oil (Ricinus communis, family-euphorbiaceae

-It is a vegetable oil extracted from castor seeds. It is a triglyceride contains ricinoleate, linoleates& oleate are other constituents. This oil treats all skin problems.

Olive oil (Olea europea, family-Oleaceae)

It is obtained from olive seeds. It consists of triglyceride esters of palmitic acid, oleic acid, traces of squalene, flavonoid and sterols. Squalene acts as antioxidant and used as a convenient vehicle in topical sunscreen preparation.

Benefits in usage of Herbal Cosmetics:

- A number of people with sensitive skin, such as those suffering from hypersensitivity of skin will not mostly prefer chemical sunscreens due to concern about skin exposure to unknown chemicals. Even though many hypoallergic cosmetics were released in market for sensitive skin, there are still limited options in sunscreens. Hence it is better to use the sunscreens containing herbal ingredients which are more suited for sensitive skin.
- Herbal ingredients used sunscreens have long history of use.
- Renewable resources.
- With small quantities they are very effective as compared to synthetic cosmetics.
- Availability of medicinal plants is not a problem especially in developing countries like India which have high agro-climate and found in large variety and quantities.
- They are safe as they are natural. No side effect is seen.

Limitation:

- No pharmacopeia defines any specific procedure or ingredients to be used in any of herbal cosmetics.
- They are difficult to hide taste and odour.
- Manufacturing process are time consuming and complicated.

FORMULATION OF HERBAL SUNSCREEN:

Example: Sunscreen Creams (o/w emulsion) formula using herbal ingredients is shown in table 2.

Table 2: formulation of sunscreen using herbal ingredients.

Ingredients	Formula %(w/w)
Stearic acid (E)	8.5
Cetyl alcohol	3.5
Starch	1.5
Sodium lauryl sulfate	1
Almond oil	15
Glycerol	3
Terminalia arjuna	3.5
Psoralea corylifolia	1.5
Glycyrrihza glabra	2
Methyl paraben	0.02
Rose oil	10
TEA (triethanol amine)	Qs

Water	Qs

Evaluation of herbal sunscreen:

- **PH of cream**- Firstly pH meter was calibrated using standard buffer[17]. Then take 0.5mg of sunscreen cream in a beaker and add 50ml of distilled water to it, mix well and test the pH of cream using pH meter.
- **Viscosity**- viscosity of the cream is evaluated using Brook field viscometer[17] at 100rpm using spindle number 7.
- **Dye test**- By using scarlet red dye we perform this test. In this test, add the dye to the cream and mix well, then take a drop of cream and place it on glass slide & cover it with cover slip. Now observe under a microscope, if the dispersed particles show red colour and the ground colourless then this type of emulsion is known as o/w type emulsion. If, the dispersed particles are colourless and the ground is red colour then this emulsion is called as w/o type emulsion.
- **Homogeneity**- homogenicity of the cream is evaluated by visual appearance and touch.
- **Appearance**- It is judged by the colour, roughness and pearlscence of the cream.
- **After feel**- Emolliency, slipperiness of the cream and amount of residue left after the application of fixed amount was checked.
- **Types of smear**- After application on the skin, the type of film or smear formed is observed.
- **Removal**- Ease of removal of cream is checked.
- **Irritancy test**- Select an area on the skin (dorsal surface of hand is preferred) and apply the specific amount of cream on the selected area and check for irritancy at regular periods for 24 hours.

RESULTS AND DISCUSSION

The SPF value produced was 24.48. PH of this herbal cream was 6.72 & it is good to skin. Viscosity of cream was 28015cps, revealing easy spreadability. The formulation didn't show any redness, inflammation & irritancy. The dye test confirmed that the cream was o/w type of emulsion. cream is non-greasy, show emollient, remain required amount of residue on skin. Easily removal with tap water.

Marketed formulations of herbal sunscreen, shows in table 3.

Table 3: Marketed Formulations:

Branded product	Herbs constituent	Manufacturer	Purpose
Lotus herbals safe sun uv screen SPF 50	Tomato	Lotus herbals pvt. Ltd, India.	sunscreen cream.
Aroma magic cucumber sunscreen lotion SPF 30	Cucumber, Cocos nucifera oil, aloevera	Blossom kochhar, India. Patanjali ayurved Ltd. India	Sunscreen lotion.
Patanjali sunscreen SPF 30	Aloe, cucumber, turmeric	Gramodaya ashram, ghazipur, India.	Moisturizing
Kadhi herbal sunscreen lotion	Aloevera, white shea butter, apple, almond oil.	John Masters Organic, New York	Sunscreen cream.
Oxyglow Aloe Vera Carrot Sun Cover Lotion SPF-30	Aloevera, carrot	Declore, Paris	Sun protecting lotion.
Aroma sun tanning gel cream SPF 10	Roman camomile, geranium, jasmine	Paula's choice, Canada	Sunscreen creams
Hydralight moisture infused lotion	Pomegranate, oat, canberry	Biotique botanical herbal extracts, India.	Sunscreen gel
Bio-pro carrot protective cream SPF 15	Carrot oil	OriflamecosmeticsSweeden	Antioxidant, antiaging.
Even out face cream SPF 20	Liquorice	Paula's choice, Canada	Sunscreen cream
Resist super antioxidant concentrate serum	Turmeric		Sunscreen cream
			Antioxidant serum

CONCLUSION:

UV radiation causes many skin related problems like premature aging, wrinkles, sunburn, suntan, skin cancer. So, everybody need protection from this harmful radiation. There are many option or different ways to protect our skin from radiation one of the better options is to prevent direct exposure to sunlight but this is impossible mainly during summer because of this reason we need to use sunscreens. Coming to sunscreen, sunscreens which are chemically formulated (synthetic) shows many side effects so to avoid this, better choice is to go with herbal formulated sunscreens as plants are known for its ability to protect themselves from harmful radiation & are more beneficial over synthetic sunscreens as they are natural in origin with no side effect, easily available, manufacturing is easy and less cost.

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