

HERBAL BIOACTIVES: A NEW PERSPECTIVE IN SKIN CARE FORMULATION

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ABSTRACT

The skin is the outermost layer of the body, which acts as a barrier to protect from the external environment, air pollutant and sunlight. Sunlight is essential for our daily life, it also stimulates the production of vitamin D and helps to control some chronic diseases like Psoriasis. Prolong exposure to UV radiation and air pollutant produces a negative effect on the skin, causing immune suppression, fine and coarse wrinkles, early skin aging, melanoma, erythema, skin pigmentation, skin cancer, sunburn, precancerous skin growth, photosensitivity reaction, acne, inflammatory or allergic skin condition. Air pollutants

and UV rays are responsible for various skin disorders such as skin pigmentation, wrinkle formation, skin aging, drying of skin, sun tan and skin cancer. Ayurvedic and other traditional system of medicines showed the benefits of uses of natural drug for treating skin diseases. Herbal cosmetics are a valuable gift of nature and its demand is growing in the world market. Herbal formulations attracted consumers because of their beneficial effect and comparatively less or no side effect. From the last few years, the growth of the cosmetic market is significantly increased, the use of herbal extract and phytochemicals has been growing interest of the consumer to avoid the unwanted effects of sunlight and air pollutants on the skin. Since long time phytoconstituents have been used in cosmetics, have proven potential in various skin-based therapy including moisturizing, anti-aging, antioxidant and sunscreen. This paper reviews the cosmetic importance of natural plant, herb that could be used in the skin care formulation, and advantages of natural skin care toward synthetic skin care.

1. INTRODUCTION

The skin is one of the largest organs in the body in surface area and weight, it shields the rest of the body from the sunlight and environmental air pollution. Sunlight emits visible light,

UV radiation, and heat, which are essential for daily life, it also stimulates the production of vitamin D and helps control some chronic diseases like psoriasis. Prolong exposure to UV radiation and air pollutant produce negative effects on the skin, causes immune suppression, fine and coarse wrinkles, early skin aging, melanoma, erythema, skin pigmentation, skin cancer, sunburn, precancerous skin growth, photosensitivity reaction, acne, inflammatory or allergic skin condition.^[1] The skin epidermal layer acts as a barrier and protect our body but air pollutants such as volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), particulate matter (PM), oxides, ozone (O₃), and sus rays penetrates in to the skin and produces harmful effects on the skin.^[2,3] Cosmetic skin care products are used to protect the skin from harmful effects. Several skin care products are available in the market, which contains a synthetic agent that produces various sensitizing reactions like photoirradiation, contact dermatitis, blockage of pores, acne, systemic and local toxicity and allergic reaction, which limits their use.^[4,5] Worldwide, Indian herbs and its significance are popular. Herbal cosmetics are a valuable gift of nature and its demand is growing in the world market. Herbal formulations attracted consumers because of their beneficial effect and comparatively less or no side effect. From the last few years, the growth of the cosmetic market is significantly increased, the use of herbal extract and phytochemicals has been growing interest of the consumer to avoid the unwanted effects of sunlight and air pollutants on the skin. Since long time phytoconstituents have been used in cosmetics, have proven potential in various skin-based therapy including moisturizing, anti-aging, antioxidant and sunscreen. Every year more than millions of people are diagnosed with skin cancer due to excessive exposure to UV radiation and air pollutants. Use of natural phytochemicals and herbal extracts in the field of skin care cosmetics and UV protection represents a new trend in the cosmetic industry. Skin care products are devised in many cosmetic formulations such as in the form of a gel, creams, lotion, emulsion, moisturizer, and other skincare products. The main purpose of use skin care product to protect the skin from the harmful effects of UVA and UVB radiation, pollutant and to preserve the moisture content of the skin.^[6] Various herbs, fruits, teas, oils, and vegetables are used as skin protective agent mainly they contain polyphenols, flavonoids, anthocyanidin, proanthocyanidin, tannins and vitamins, which are mostly antioxidant they can scavenge free radicals and have a protective effect from harmful UV radiation and air pollutant.^[7] Phytochemicals such as resveratrol, quercetin, apigenin, chrysin, silymarin, rutin, glycyrrhizin, gallic acid, caffeic acid, ferulic acid, curcumin, vitamin C, vitamin E, carotenoids, etc.^[8,9,10]

1.1 Skin

The skin is the outermost layer of the body, which acts as a barrier to protect from the external environment. The skin composed of many epithelial and connective tissues which are protective in function. The skin is the coetaneous membrane covers all body which is the largest organ of the body about 10% of body weight of an average, having area about 1.7 square meters and weighs 4.5-5 kg, It is 0.5 – 4 mm thick, thinnest on the eyelids, The facial skin is the thinnest, thickest on the heels the average thickness is 1 – 2 mm.^[11]

1.1 Anatomy of skin

Human skin is mainly divided in to the three layers

1. Epidermal Layer
2. Dermal Layer
3. Hypodermal Layer

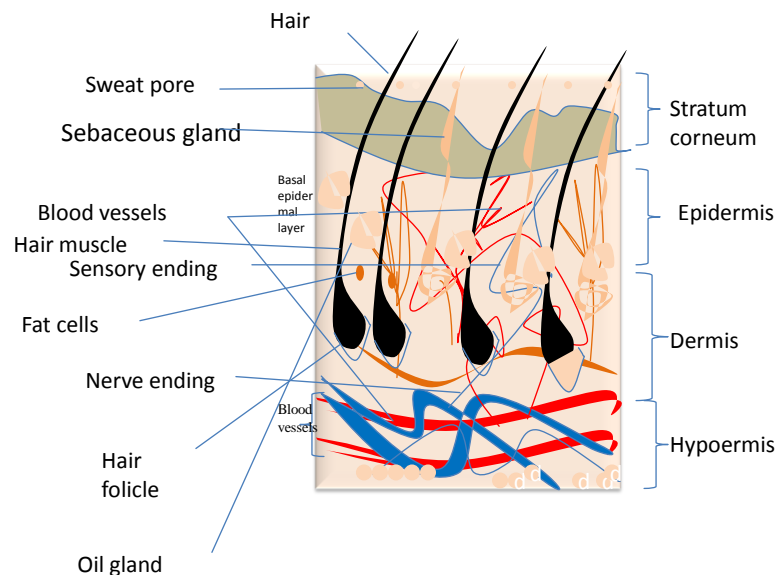


Fig.1: Structure of Skin.

1.2 Epidermal Layer

Epidermal layer is the outermost layer of the skin act as a physical and biological barrier to the external environment, prevents the loss of water and maintains internal homeostasis, preventing penetration by irritants and allergens, stratified squamous epithelium mainly composed of keratinocytes, produces the protein keratin and are the major building blocks of

the epidermis. They produce the pigment melanin, manufactured from tyrosine, which is an amino acid, packaged into cellular vesicles called melanosomes, and transported and delivered into the cytoplasm of the keratinocytes.^[12-15]

Epidermis forms the four layer, but those with the thickest skin have five layer.

1. Stratum basale (basal germinative layer),
2. Stratum spinosum (spinous or prickle cell layer),
3. Stratum granulosum (granular layer).
4. Sstratum corneum (surface horny layer)
5. Stratum lucidum (only found in thick skin – that is, the palms of the hands, the soles of the feet and the digits).

1.3 Dermal epidermal junction

This is structure situated at dermal and epidermal junction which is a narrow, undulating, multi-layered structure which acts as a cohesion between the two layer, This junction also acts as a barrier to restrict the movement of inflammatory and neoplastic cells between the dermis and epidermis.^[15]

It consists of Lamina lucida and Lamina densa two layers. Thinner layer lamina lucida lies directly beneath the stratum basale and thicker layer lamina densa is in direct contact with the underlying dermis.

1.4 Dermal Layer

Dermis is the inner layer lies between the epidermis and the subcutaneous adipose tissues. Dermis consists of about 15-20 % of total body. Dermis composed of mast cells and fibroblasts, ground substances, blood vessels, lymphatics, sweat glands and nerves.^[16-18]

1.5 Hypodermal Layer

This layer contain subcutaneous tissues lying below the dermis. It consists of mainly fats and provides insulation to the body from the cold, aiding shock absorption and provides main structural support for the skin. It composed of blood vessels and nerves.^[19-21]

1.6 Function of skin^[20,22]

- It acts as protective barrier and protects the body from harmful agents, mechanical, thermal and other physical injury.

- Thermoregulation –Skin protect the body from cold or heat and maintain the constant temperature of body. Blood flow through the cutaneous vascular bed maintain body temperature. During warm period blood vessels dilate and skin becomes red and forms sweat, while In cold periods the blood vessels constrict and preventing heat from escaping.
- Sensation-Skin acts as the sensory organ
- Skin involved in the synthesis of vitamin D and also contains receptors for the steroidal hormones like oestrogens, progestogens and glucocorticoids and for vitamin A.
- Has a cosmetic, social and sexual association.
- Plays a role in immunological surveillance
- Protect from harmful effects of UV radiation
- Prevent excessive loss of moisture and protein.

2. UV- RADIATION

Classification of UV Radiation-UV light are classified according to its wavelength broadly into three types.

- ❖ Ultraviolet A (UVA): 320-400 nm this rays cause skin aging, wrinkles, damage to cells DNA and play role in some skin cancer.
- ❖ Ultraviolet B (UVB):280-320 nm this ray has slightly more energy than UVA rays they can damage directly DNA in skin cells, sunburns, and skin cancer.
- ❖ Ultraviolet C (UVC):280-200 nm These rays have more energy and more dangerous than UVA and UVB rays but they blocked by the ozone layer and don't reach to the ground and your skin normally hence they are not at risk of skin cancer but they can also man-made source like a welding torch, mercury lamps, and UV sanitizing bulbs which are used to kill bacteria and germs.^[23-25]

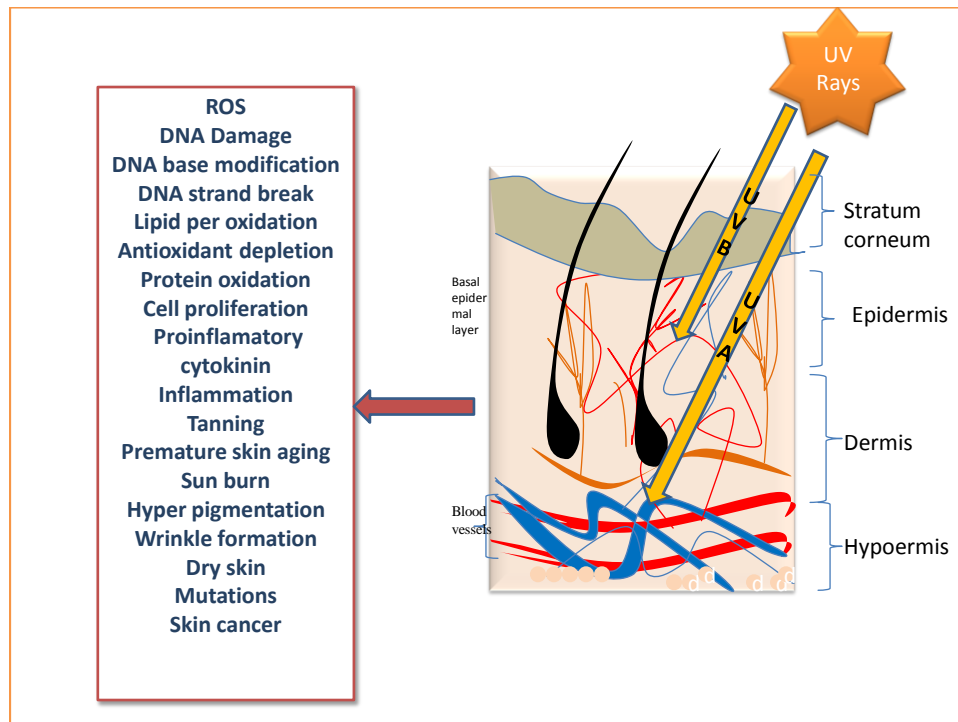


Fig. 2: Effect of Sunlight on Skin.

2.1 Effect of Sunlight- Excessive exposure to UV rays it causes a number of health and skin complication^[26,27] shown in fig 1.

Premature aging –Exposure to sun rays causes premature skin aging called as photoaging, associated with freckling, fine wrinkling, dilation of capillaries, irregular pigmentation, and loss of elasticity.^[28]

Suppression of Immune system-Overexposure to UV radiation it alters the immune system functions which reduce the body’s ability to fight with certain diseases and interfere with the effectiveness of immunization given through the skin.^[29,30]

Cataract and eye disorder-excessive exposure to UV radiation increases the risk of cataract and other eye problems.

Heat Exhaustion-People working in a hot environment are at risk of heat exhaustion which is associated with excessive water and salt loss, it includes nausea, dizziness, headache, weakness, thirst, elevated body temperature, decreased urine output.

Malignant melanoma-It occurs in young women especially at the age of 18 and 29 years, it is very dangerous and affects any area of skin where there are pigment-producing cells, which may include the entire skin.^[31,32]

2. Air Pollutants

1. Polycyclic Aromatic Hydrocarbons (PAHs)-This are organic pollutants from residual wood burning, automobile fumes and combustion smoke from organic material.^[33,34] This pollutant causes skin pigmentation, PAHs are converted into redox-cycling chemicals and quinines, responsible to produce reactive oxygen species (ROS) adsorbed on the surface of Particulate Material (PM) on prolonged exposure to this PM bound Polycyclic Aromatic Hydrocarbons absorb through hair follicle to epidermis leads to various toxic oxidative stress and skin aging or directly affect the function of cutaneous cells, causes skin cancer (cutaneous cancer), this is associated with interaction with UVA.^[35,36]

2. Oxides-NO_x and NO₂ are mainly formed due to emission of mobile and stationary combustion which react with atmospheric O₃ or radicals. These free radicals oxidize amino acid present in tissue protein and causes oxidative damage due to lipid peroxidation of polyunsaturated fatty acids, which act as irritants and immunomodulators, dermatitis and eczema.^[37-41]

3. Volatile Organic Compounds (VOCs)-Varnishes, organic solvents in paints, exhaust from cars, environmental tobacco smoke, repairing car paints, exhaust from cars, emission from industries emits volatile organic compounds (VOCs).^[40,42] Which produces photochemical oxidants in presence of sunlight and NO_x leads to precancerous lesions, inflammatory allergic dermatitis reaction.^[43-44]

4. Particulate Matter (PM)- Industries, power plants, refuse incinerators, natural windblown dust, construction activities, fires and automobiles are the main sources of particulate matter.^[40] Nano size particles from traffic sources are highly reactive and induce oxidative stress leading to skin aging, pigment spots and wrinkles.^[33,45-47]

5. Cigarette Smoke-Environmental cigarette smoke contains carcinogenic compounds such as 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanone (NNK), benzo [a] pyrene, reactive oxygen species (ROS), reactive nitrogen species and electrophilic aldehydes leads to lipid peroxidation, transepidermal water loss, increase of matrix metalloproteinases (MMP-1,

MMP-3) and degeneration of connective tissue in the skin. Deeper periorbital wrinkling and orange-purple skin discoloration associated with smokers and sun exposure.^[45,48-50]

3.Skin Disorder- Skin aging-Long time exposure to sunlight and air pollutants leads to the development of chronic and acute skin complications. UV –light with environmental pollutants generate formation of ROS and RNS (reactive nitrogen species) affect the structural and functional properties of cutaneous protein e.g. elastin, collagen and glycosaminoglycans which is responsible for skin aging.^[28,56-60]

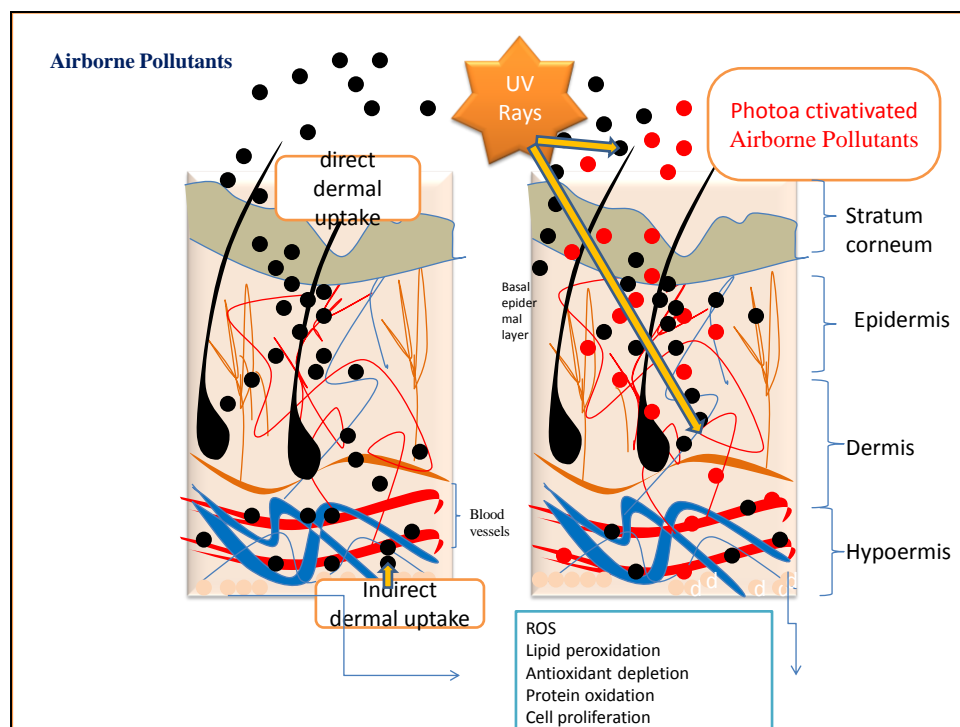


Fig. Effect of Sunlight and Air Pollutant on Skin.

Wrinkle formation- Exposure to sun light and environmental factors (air Pollutants) leads to the formation of ROS results in oxidative photo damage of protein and other macromolecules results in overproduction of elastases, reduction in collagen and deposition of glycosaminoglycans which affect the elastin fiber network, leads wrinkling and sagging of skin.^[61-66]

Hyper pigmentation- Melanin is the main defensive pigment arresting skin damage caused by UV light and responsible for color production of skin. Melanin is produced by melanocyte cells in the stratum basal layer of the epidermis.^[67-69] Hyper pigmentation occurs due to over generation of melanin due to enhanced activity of tyrosinase which results in melasma, solar

lentigo and post inflammatory melanoderma, chloasma dermatitis, geriatric pigment spots and freckles.^[66,70-72]

Sunburn-UV-B radiation responsible for sunburn and sun tan.^[73] UV- B rays are 30-40 times more potent, energetic and deeply penetrate into the epidermis of the skin absorbed by DNA of keratinocyte induces erythema, sunburn, tanning, immunosuppression and cancer of the skin.^[76-81]

4. Plants used in skin care

Plant phytoconstituents are gaining popularity due their antioxidant potential, less expensive, no side effects. Based on ethnobotanical and traditional uses natural resources are used for skin care and for improving physical appearance and beauty of skin Nowadays skin care maintenance has become much more widespread and increase the demand of herbal extract for skin cosmetics.^[82] UV radiation, air pollutants, chemicals, and environmental factors responsible for generation of ROS (ions,peroxides and free radicals)damage DNA telomers, cell membrane and enzymes. which causes skin aging.^[83-84] Synthetic agent used in skin care cosmetics produces allergic reaction, such as allergic contact dermatitis, irritant contact dermatitis, phototoxic and photoallergic reactions.^[85-86] demand of safe herbal extract loaded skin care cosmetics is the choice and emerging need in the field of skin care cosmeceuticals. Herbal cosmeceuticals is the fast growing segments in the world due to its significant impact on skin disorder. Herbal phyconstituents are safe, easily absorbed in the skin produce protective biological function, provide nutrition for the healthy skin, Herbal drug containing flavonoids, polyphenolic compound having antioxidant free radical scavenging effect which eradicate by product metabolism, reduce the formation of ROS and prevent early skin aging, repair skin damage, prevent erythema. Polyphenolic active constituents of plant have been shown effective to heal, restore, nourish, improve skin texture and protect the skin.^[87-89] Plants used in skin has been given in table 1.

Table 1: Plants used in skin care cosmetics.

Sr. No.	Name of Plant	Active constituents	Skin care cosmetic use	Reference
01	<i>Aloe barbadensis</i>	Aloin, Mannose6-phosphate	Wound healing, Moisturizing, humectants	[90,91,101, 115]
02	<i>Camellia sinensis</i>	epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin gallate	Antioxidant, antiaging, antiinflammatory, Photoprotective	[92,93,94,168]
03	<i>Curcuma longa</i>	curcumin	anti-inflammatory, antibacterial,antioxidant, moisturizing	[95,96,97]
04	<i>Embilica officinalis</i>	Vit C, gallic acid, ellagicacid	Antioxidant,nourishment, ,photoprotective,moisturizing	[98,99,100]
05	<i>Daucus carota</i>	B-carotene, Vit A	Rejunevating,revitalizing,antiaging	[101]
06	<i>Bacopa monnieri L.</i>	Quercetin, saponin Bacoside A, along with Bacoside A3, Bacopaside II,	Antioxidant	[101,102,103]
07	<i>Calendula officinalis</i>	lutein, lycopene, and xanthophylls,flavonoids, α -thujene, α -pinene, 1,8-Cineole, dihydrotagetone and T-muurolol	Antioxidant,antiinflammatory, Wound healing,photoprotective	[104,105,]
08	<i>Ginkgo biloba</i>	flavonoids and terpenoids	protect the skin damage, antioxidant, anti-inflammatory, and anti-aging activity, improving skin quality, reducing wrinkles, and fine lines maintains the firmness of the skin, improve and enhances the collagen production in the skin,photoprotection	[106,107]
09	<i>Rosmarinus officinalis</i>	Phenolic diterpene	Antiaging,antioxidant, skin rejuvenator, Antimicrobial,antiwrinkle	[108,109,110]
10	<i>Alium cepa</i>	proteins,carbohydrates, sodium, potassium and phosphorus	Antimicrobial,wound healing,antiinflammatory	[111,112]
11	<i>Azadirachta indica</i>	Azadirachtin,nibine,nimbidiol	Antimicrobial	[113]
12	<i>Ocimum sanctum</i>	Eugenol, caryophylline, vit.C	Antiaging.antibacterial,Wound healing,	[113,119]
13	<i>Rubus idaeus</i>	Ellagic acid, sanguin H-6,	Antioxidant, antiinflammatory,protective,	[114,115]

		anthocyanins and ellagitannins		
15	<i>Glycerrhiza glabra</i>	Glycerhizin, glabiridin, saponins,	Skin whitening, antiaging, emollient, anti-acne and photo protection.	[114,119,211,226]
16	<i>Cinnamomum zeylanicum Blume</i>	tannin, phenol, flavonoids	Acne,skin imperfection, antimicrobial	[116,117,118]
17	<i>Eucalyptus globulus</i>	Cineol,eucalyptol	Acne antimicrobial	[119,120]
18	<i>Rubia cordifolia</i>	rubiprasin A,B,C, ruiearbons, aborane triterpenoids, mangistin, alizarin, garancin, mollugin, furomollugin	Wound Healing, Lighten Pigmentation Marks,skin soothing	[119,120,121]
19	<i>Crocus sativus</i>	quercetin and kaempferol	Antiallergenic, Imparts Smoothness to skin	[119]
20	<i>Pterocarpus santalinus</i>	Bisabolol, Squalene, cedrol, Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester, P-Cresol, (-) - Spathulenol and Heptacosane.	Good for Skin, Anti -Acne	[122,123]
21	<i>Nelumbo nucifera</i>	Flavovoids, megastigmane, nelumnucifoside A (1), and a new eudesmane sesquiterpene, nelumnucifoside B	Moisturize the skin and youthful looking, Anti-oxidant,	[119]
22	<i>Pterocarpus marsupium</i>	Pterostilbene	Antiging, antioxidant, photoprotective	[124,125]
23	<i>Sida cardifolia</i>	flavonol C-glycosides,kaemferol	Wound healing,antimicrobial	[128]
24	<i>Acorus calamus</i>	Acorine,saffrole,eugenol	Wound healing,antioxidant,antimicrobial,antiinflammatory	[129,130]
25	<i>Abutilon indicum</i>	asparagines. Saponins, flavonoids, alkaloids, β -sitosterol, vanillic acid, p-coumaric acid, caffeic acid, fumaric acid, abutilon A,	Wound healing, antioxidant,antimicrobial	[126,127]
26	<i>Mesua ferrea</i>	Mesuferrol-A and -B, (-) epicatechin	Wound healing, antioxidant,antimicrobial	[131]
27	<i>Moringa oliefera</i>	Morin	Antioxidant,photoprotection,	[132,133]

			Revitalization,antiwrinkl	
28	<i>Santalum album</i>	Santalene	Revitalizing,Antimicrobiala,cne, psoriasis, eczema, Antiaging	[134,135]
29	<i>Pterocarpus santalinus</i>	isabolol, Squalene, cedrol, Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester, P-Cresol, (-) - Spathulenol and Heptacosane.	Antiaging,antiwrinkle, cell rejuvenation	[135,136]
30	<i>Carica papaya</i>	Papain	Antiwrinkle,photoprotection, Acne,cell rejuvenation	[137,138]
31	<i>Areca catechu</i>	Catechin	Antioxidant,wound healing	[139]
32	<i>Cucumis sativus</i>	ascorbic acid and caffeic acid	Antioxidant,photoprotection, improve complexion, skin rejunevation, dermatitis,burns, photoprotection	[158,140]
33	<i>Arnica montana</i>	Caffeic acid, apigenin,hisperidine,limonene	Antioxidant, protective, antimicrobial, antiinflammatory	[141]
34	<i>Vitis vinifera</i>	Proanthocyanidins,flavonoids	Antiaging,antioxidant, Photoprotective, antiwrinkle	[171,142,143,144,145]
35	<i>Solanum lycopersicum L.</i>	Lycopene, leutin, B carotene, Vit.A,Mg,K, Vitamins	Antiaging, skin tightening, rejunevating,haeling,antioxidant,photoprotective.	[146]
36	<i>Punica granatum</i>	Punaci	Antiaging, antioxidant,antiwrinkle	[147,148]
37	<i>Citrus reticulata Blanco</i>	Flavonoids, Polymethoxyflavones.	Antiaging, antiwrinkle	[149,150]
38	<i>Panax ginseng</i>	ginsenosides, polysaccharides, triterpenoids, and flavonoids	Antiaging, antiwrinkle, skin whitening	[151,152,166,167]
39	<i>Morus nigra</i>	Flavonoids,polyphenol and tannin	Antibacterial,antiacne	[153]
40	<i>Cucurbita pepo L</i>	α -tocopherol	Antioxidant	[154]
41	<i>Aricaria recutita</i>	Chamomile	Antioxidant	[155]
42	<i>Nardostachys jatamansi</i>		Antioxidant	[156,157]
43	<i>Annova squamosa</i>	Flavonoid.,tannin,polyphenols	Antiaging,antiwrinkle,antioxidant	[158]
45	<i>Syzygium</i>	Polyphenols	Antiacne,antioxidant,antimicrobial	

	<i>samarangense</i>			[159]
46	<i>Withania somnifera</i>	Withanolide	Antiacne,skin whitening,antioxidant	[160]
47	<i>Hibiscus sabdariffa</i>	Anthocyanin,polysacchrides	Antiaging,moisturizing,antioxidant,wound healing,photoaging	[161,162]
48	<i>Psoralea corylifolia</i>	flavonoids, tannins, phenoles, saponins, carbohydrates, alkaloids, coumarins and psoralens.	Antimicrobial,eczema,antiaging	[163,164,165]
49	<i>Camellia oleifera</i>	Polyphenols	Skin rejuvenation	[165]
50	<i>Pleurotus ostreatus</i>	polyphenols	Antimicrobial,antioxidant	[168]

CONCLUSION

The cosmetic products are used to protect skin from harmful effect of air pollutants and UV radiation. Since long time phytoconstituents have been used in cosmetics, natural herbs have been proved potential in various skin based therapy including moisturizing, antiaging, antioxidant and sunscreen. Use of natural phytochemicals and herbal extract in the field of skin care cosmetics and UV protection represents a new trend in the cosmetic industry. The herbs containing antioxidant and Polyphenols have been proved beneficially protect the skin from harmful effect of oxidative stress, this paper would be helpful for the researcher to formulate safe, effective, and stable skin care product.

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