German J Pharm Biomaterials 2023; 2(3): 9-31
https://doi.org/10.5530/gjpb.2023.3.8

GJPB

Review Article

Potentials of plant derived products for the treatment of skin disorders

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Received: 29 March 2023; Revised: 08 June 2023; Accepted: 20 June 2023

Abstract

The skin is the body's largest organ. The epidermis and dermis make up the skin, and their primary purpose is to defend the body from adverse environmental factors like chemicals, allergens, toxins, and bacteria. Many different types of natural products have shown promise in the treatment of skin disorders. Multiple synthetic chemicals and environmental pollution have an impact on modern human existence. Therefore, nature has provided several essential ingredients for boosting skin health and shielding skin from environmental damage. The most significant in vivo and in vitro studies on the use of different natural products in inflammatory, cancerous, and skin infection disorders and their mechanisms of action were summarised in this review. The study also highlights the potential photoprotective effects of numerous herbal ingredients. Sunburn is caused primarily by the sun's ultraviolet rays, which can also cause cancer of the skin. Herbal ingredients with sun-blocking properties can prevent the penetration of harmful ultraviolet radiation. Compared to their synthetic counterparts, herbal remedies have fewer adverse effects and are just as effective in treating chronic conditions. Flavonoids, polyphenols, carotenoids (Lycopene, carotene), and phenolic acids found in herbs rich in vitamins (A, C, and E) have antioxidant properties that increase photoprotection.

Keywords: skin disorder; natural products; toxicity; psoriasis; skin cancer; anti-inflammation

Introduction

The epidermis, dermis, and hypodermis are the layers that makeup skin, which is the largest organ of the body. By providing protection and serving as a barrier to the body, the skin plays a crucial role. Additionally, it controls body temperature and increases sensation. Skin disorders are people's main concern when it comes to their skin. In fact, one in three adults over the age of 18 shows mild or chronic skin conditions, and 50% of adults have experienced one or more types of skin disorders at certain points in their lives [1].

Skin

The skin protects the internal organs against a variety of outside influences, including invasive infections (caused by bacteria, fungus, mites, viruses, and parasites), exogenous physical stimuli, chemicals, and others. The body receives vital vitamins like Vitamin D from the skin, which also plays a crucial role in controlling temperature, electrolytes, hydration, and other factors. Skin also has a stronger, drier (due to lipids) and dry epithelial layer than other mucosa, which makes it more resistant to microbe penetration. Dysregulations in the skin-associated lymphoid system cause chronic inflammation and hyper-proliferation skin conditions. Additionally, many bacteria prefer to enter the body through the skin, which is damaged or thin. Controlling immune responses in the skin is, therefore, essential. In the skin-associated lymphoid system, the innate and adaptive immune systems are intricately synchronized.

Along with the innate immune system, the humoral immunity of the adaptive immune system, also known as antibody-mediated immunity, is crucial for maintaining the immune homeostasis of the skin. B-cells and their subtypes have been associated with skin-based antibody-mediated protective immunity. However, either self-reactive or/and non-self-reactive antibody production [2].

Defence through mediated immunity determines whether self- or non-reactive antibodies are produced, though antigen type (self / foreign) exposed, and may stimulate or inhibit the inflammatory response. Therefore, in the skin, B-cells play a role in both pathogenic and homeostatic processes. It is well known that during inflammatory diseases, localized skin-resident B-cells migrate to the skin by expressing cutaneous lymphocyte-associated antigen (CLA) and chemokine receptors, despite the fact that little is known about these numerous autoimmune skin diseases have been linked favourably to the infiltrating B-cell subsets. Additionally, in the absence of primary and secondary lymphoid organs, skin-homing B-cells respond to local antigens and produce antibodies [3]. These antibodies are essential in autoimmune diseases. Certain B cell-mediated autoimmune diseases are primarily brought on by autoreactive B cells, which may not even involve T cells. The skin's autoreactive B-cells could have an unknown origin. Autoreactive B-cell production is anticipated to occur in secondary lymphoid organs or bone marrow. The process by which these cells are produced by eluding the central or peripheral tolerance checkpoints is still unknown. The systemic secretion of autoantibodies begins when autoreactive B-cells in the germinal centres begin to differentiate into memory B-cells and plasma cells. Plasma cells have the innate ability to travel to the bone marrow after coming into contact with an antigen, where they mature into a reservoir for an extended period—possibly even the rest of a person's life of autoantibody secretion. Autoantibodies are thought to be a unique diagnostic tool for autoimmune diseases that affect the skin. The autoimmune condition is amplified or made worse by skin-resident autoreactive in a number of ways, including IgM, IgG, and IgA secretion, antigen presentation, T-cell stimulation, pro- and anti-inflammatory cytokine (IL-6, IL-10, and TGF-), and growth factor (platelet-derived growth factor, basic fibroblast growth factor) secretion in the microenvironment [3].

Innate and Adaptive Immune System of the Skin

The innate immune system of the skin, which is made up of keratinocytes, monocytes, macrophages, Langerhans cells, dendritic cells, mast cells, and proteins related to complement, serves as the body's first line of defence [4]. The antimicrobial peptides defensins, which are specifically secreted by keratinocytes and mast cells, also start the inflammatory response. The host's innate defence cannot completely protect against infection and is unable to prevent reinfection. The secreted mediators of the innate immune system, however, also activate tissue-resident lymphocytes, particularly T cells, and nearby borers. The effect of fibroblasts on T lymphocytes is independent of the cytokines and chemokines secreted by melanocytes [5]. Together with innate immune system actions, T-cells, B-cells, and NK cells comprise the adaptive immune system, illustrating the interaction of the innate and acquired immune systems during cutaneous bacterial infection. Although the host's innate defence can prevent reinfection to a certain extent due to the antigen-nonspecific mechanism discussed above, they cannot completely prevent infection. The innate immune system's mediators, particularly those released by T cells, also stimulate nearby cells and lymphocytes that are present in the tissue. In addition to the cytokines and chemokines that melanocytes secrete. Fibroblasts also influence T lymphocytes. Together with innate immune system functions, the T-cells, B-cells, and NK cells that make up the adaptive immune system show how a bacterial infection on the skin affects the interaction between the innate and acquired immune systems. Despite the fact that B-cells play a very small direct defence role, T-cell-mediated immunity is well-documented in skin diseases. It is interesting to note that T cells are twice as common in healthy dermal tissue as they are in blood. The T-cells in the skin-draining lymph nodes receive self- and non-self-antigens from the innate system's LCs and DCs. The lymph nodes produce T effector cells (TEM, effector memory T-cells), which migrate to the infection or damage site. Lymph nodes contain some T-cells (TCM, Central memory T-cells) that are a source of skin T-cells. T-cells divide and grow as soon as they enter the skin, giving rise to a number of subsets, including Th1, Th2, Th17,

Th22, and Treg cells. Each subset has a specific function to perform in order to maintain homeostasis. B-cell defence mechanisms and B-cell activation are both supported by T helper cells [6].

Innate cells begin the resolution phase by producing various immunosuppressive signals, such as immunomodulatory cytokines (IL-10, TGF-) or immunosuppressive mediators (indoleamine 2, 3 dioxygenase), selective receptor antagonists (interleukin-1 receptor antagonist), activating Tregs, and others, once the defencing system is complete by killing the pathogens or removing damaged cells. The elements mentioned above establish pre-inflammatory/homeostatic conditions in the skin and regulate the inflammatory cellular response according to their functional roles. The aberrations/excessive immune response, on the other hand, results in a variety of diseases, including autoimmune diseases, such as antigen-presentation, cytokine secretion, and differences in self and non-self-differentiation. On the other hand, skin that has a poor immune response is more vulnerable to tumours and infectious diseases. Different substances, including chemicals, microorganisms, radiation, and others, can impair immune surveillance. Eczema, fungal infections, benign tumours, and viral warts can all be considered skin disorders or diseases. Age-related factors may also play a role in other skin conditions, such as acne, atopic dermatitis, wounds, skin cancer, psoriasis, and iatrogenic dermatitis [7]. Numerous skin conditions affect people. It is crucial to understand the distinctions among these infections, which are broken down into types because some of their symptoms are similar to the most prevalent skin infections. The way of life, such as diet, is one of the other influencing factors. For instance, high dietary fibre intake of fatty or oily foods, sweet foods, chocolates, dairy products, and nuts is associated with facial acne or the worsening of acne. The socioeconomic status of the populace is another risk factor causing skin conditions to worsen. An increase in the need for treatment of skin infections and eczema in this population may be caused by lower socioeconomic status affecting access to healthcare. Skin conditions have been shown to affect a patient's daily physical, social, and psychological characteristics. The extent of the rash and the location that may cause itching and flaking have a physical impact. Another significant skin condition that can cause excruciating itching is psoriasis. Social impact, meanwhile, refers to how people interact with one another and how a person with a skin condition might withdraw from others. Skin disorders lead to psychological effects in terms of anxiety as shown in Figure 1.

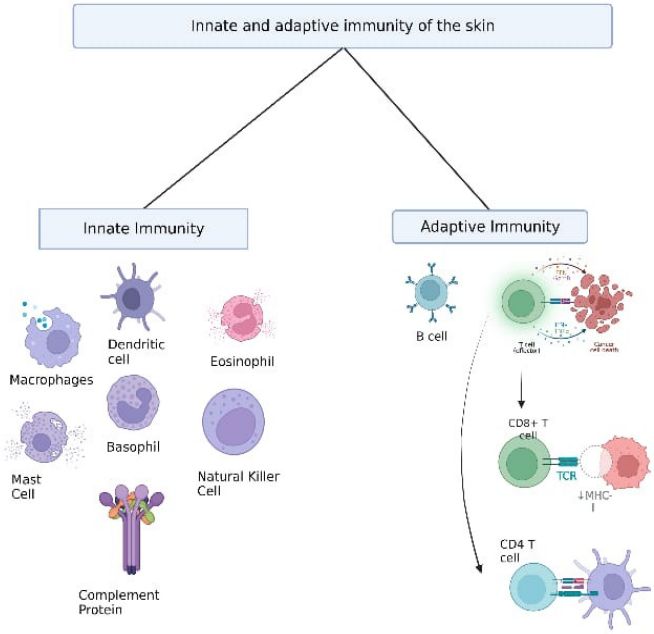


Figure 1. Innate/ Adaptive skin immune system.

Role with importance of natural products for drug development against skin disorders

Natural substances, especially botanicals, are permanently used as therapeutic candidates in contemporary medicine. These botanical products have a traditional reputation regarding fewer side effects. In less developed nations, the local populace occasionally relies on instinctive dosage or prescription medications to regulate their skin environments and healthcare. Due to their moderate effectiveness and accruing effect, open commodities primarily aid in the treatment of severe and chronic continuous manifestations [8]. Additionally, because they have fewer side effects, natural products are better able to balance out the various targets with different active principles when treating chronic complex diseases. According to numerous studies, natural products have a wide range of applications

and advantages, including antimicrobial, wound healing, the treatment of burn injuries, and acting as an anti-inflammatory against different skin disorders. Natural products are typically made by combining plant parts like leaves and roots. Natural products, particularly plants that have few constituents, generally are a subject of research in drug development [9]. According to their role in a fundamental metabolic process, the plant constituents, or phytoconstituents, are divided into primary and secondary metabolites. Secondary pathways form secondary metabolites as by-products, and they are used as the key ingredients in the production of medications; primary metabolites typically imply the basic life functions, making them similar in all biological cells. Amino acids, nucleic acids, sugars, tricarboxylic acids, polysaccharides, and proteins are all included in primary metabolites [10]. In drug incidents, the investigators frequently conduct research on natural objects, particularly plants that are accompanied by a few other elements. The components of plants, or phytoconstituents, are divided into basic and sub-ordinate metabolites based on how they function in fundamental metabolic processes. Basic metabolites typically represent the fundamental processes of life, while secondary metabolites are the byproduct of auxiliary pathways that may be the key ingredients in drug production [10].

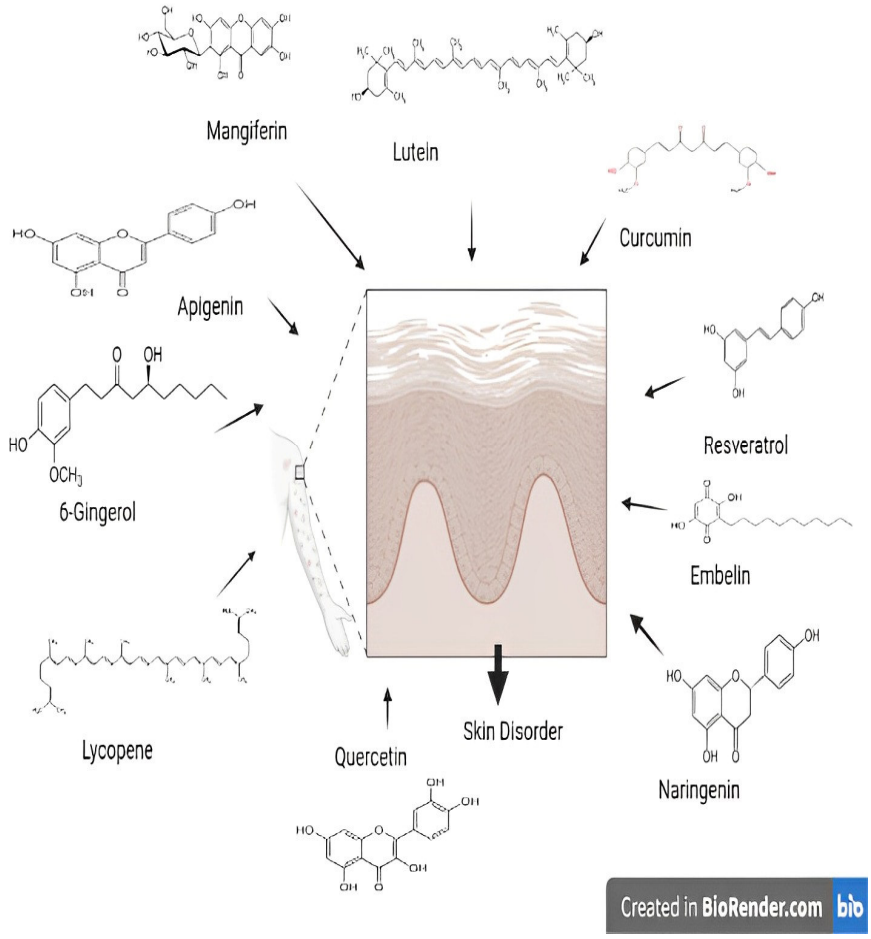


Figure 2. The effect of medicinal products against skin disorders.

Amino acids, deoxyribonucleic acid, sugars, tricarboxylic acids, polysaccharides, and protein are all included in basic metabolites. The classes of secondary metabolites include phenolics, lipids, saponins, carbohydrates, alkaloids, and terpenes, among others. The therapeutic roles played by these phytoconstituents vary. Among the aforementioned secondary metabolites, phenolics play a protective role against oxidative damage disease because they typically serve a plant's first line of defense against pathogens and are also essential to plant growth and reproduction. Alkaloids, nitrogen-containing components, are also useful as drugs, especially psychoactive drugs, medicines, and poisons, because they may be used to relax muscles, treat pain, and act as an anesthetic. Saponins are helpful in the treatment of cancer, bone health, lowering blood cholesterol, and boosting the immune system. Terpenes, one of the other constituents, was advantageous for the taste, fragrance, pigment, thermos-protective, and signaling functions of the plant, as well as therapeutic applications like anti-inflammation, wound healing, and anti-bacterial properties. Subordinate metabolite classes, including phenolics, lipids, saponins, hydrogen, alkaloids, and terpenes, among others. The various healing functions of these phytoconstituents are diverse. The researchers were interested in creating herbal

medicines or natural products to treat different diseases, particularly skin conditions, because of the nature of phytoconstituents. Tea tree oil, honey, and vitamins C and E can all help to improve skin health and lessen the signs of skin disease. Due to the nature of phytoconstituents, researchers were interested in creating non-affected produce or herbal remedies to treat a variety of ailments, particularly skin conditions like vitamins, to some extent (Figure 2).

Amino acids, deoxyribonucleic acid, sugars, tricarboxylic acids, polysaccharides, and protein are all included in basic metabolites. The classes of secondary metabolites include phenolics, lipids, saponins, carbohydrates, alkaloids, and terpenes, among others. The therapeutic roles played by these phytoconstituents vary. Among the aforementioned secondary metabolites, phenolics play an Aloe Vera, which is frequently used to treat skin conditions because it has anti-inflammatory effects and good antioxidant properties. Therefore, we can conclude that natural products are frequently used in treating a variety of skin disorders because of their broad advantages and versatility. In addition to being secure, natural products are derived from natural sources like fruits and vegetables. By analyzing the most significant studies carried out to date [11]. This article aims to provide current knowledge about the effects of natural plants on skin conditions, including Mangiferin, lutein, curcumin, resveratrol, embelin, naringenin, quercetin, lycopene, gingerol, and apigenin. It also makes suggestions for future research [12].

Mangiferin

Mangiferin usually originates from Mangifera indica (the mango), a member of the Anacardiaceae family. Mangiferin, also known as 2-C-D-glucopyranosyl-1,3,6,7-tetrahydroxyxanthone, is a synthetic substance with both pharmacological and organic characteristics as shown in Figure 2.1 [13]. As a chemopreventive, antioxidant, and antagonistic-angering, it performs well. It is noteworthy that it has cytotoxic properties against tumor cells where apoptosis takes place. When combined with the antioxidant effect, it supports significant skin benefits by irritating deeper skin coatings [9-13]. Mangiferin can keep the skin smooth and prevent wrinkles by preventing the breakdown of collagen and elastase, as well as water misfortune, which is why it is used to fight skin fermenting. As collagen deteriorates, the activity of a model-degrading substance called forge metalloproteinase (MMP) increases. The increased MMP activity promotes photo-crumbling, which accelerates skin fermenting, which is regulated by ERK and JUN-N-terminal kinases (JNK); it is claimed that MMP-1 is a significant and administrative of collagen depravity caused by oxidative stress biomarker connected to rash. By limiting the MEK, SEK, ERK, and JNK pathways in addition to the ERK and JNK pathways, which are two together mobilized by hydrogen whiten, mangiferin prevents the MMP-1 verbalization cruel epidermal keratinocyte line (Ha Cat) containers [14]. Mangiferin, which also creates the MEK and ERK pathways, inhibits the MMP-9 venture.

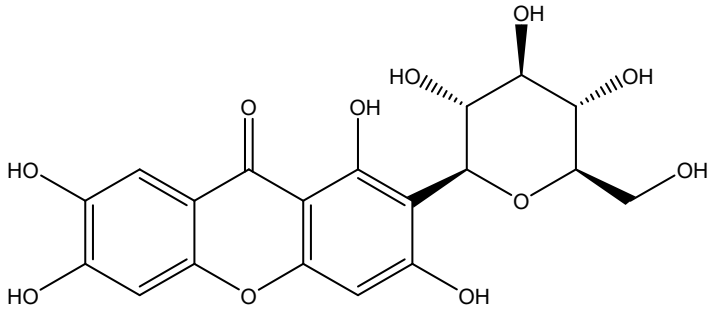


Figure 2.1. Chemical structure of Mangiferin.

Additionally, mangiferin taken orally lessens the occurrence of wrinkles brought on by UVB rays, which results in skin aging. Mangiferin combined with nanoemulsions can still enhance skin healing and reduce transistor-P (TPA)-induced skin damage [15]. Mangiferin has been demonstrated in earlier studies to reduce skin inflammation and subdue the inflammatory response induced by macrophages. Mangiferin also lessens inflammatory mediators like tumor necrosis factor-alpha (TNF-). It attracts inflammatory biomarkers involving reasoning from facts nitric oxide synthase (iNOS), interleukin (IL)-

1, and IL-6 that are responsible for skin lesions like psoriasis. Mangiferin can inhibit CD68 activity, a significant macrophage biomarker linked to rash [16]. Mangiferin can treat skin conditions like wounds and speed up skin aging. In addition to being a strong antioxidant, it strengthens wound healing [17]. Mangiferin advances skin flap conversion and reduces inflammation thanks to its allure, anti-inflammatory and antioxidant properties. By promoting fibroblast shift and container increase during the wound healing process while restricting the activity of the agitating thing that instigates the activity of myeloperoxidase (MPO), it promotes wound healing [18].

Additionally, mangiferin-tricky liposomes are a direct local treatment for skin flap conversion because they have a potent healing property that preserves the skin flaps [19]. Mangiferin inhibits the expression of IL6, TNF, PLAU, kinase control receptor (KDR), vascular endothelial development factor receptor 2 (VEGFR2), interferon-gamma (IFN-), FGF1, chemokine ligand 2 (CCL2), MMP19, and placental. However, a nucleoside is currently the best treatment option for HSV [20,21].

Lutein

The xanthophyll produces lutein carotenoids, and Lutein is lipid-soluble. Lutein, as shown in Figure 2.2, which is crucial for maintaining sharp vision and primary vision, is found in tissues of the eye, such as the lutea and glass, and it is a vital part of antitoxin [22]. The diet also includes Lutein, which may be found in salads that are dark and shaded. The eight isoprene parts, each of which contains two oxygen atoms, are made up of the 40 element atoms that make up Lutein [23]. Although taking into account age-related macular degeneration (AMD) and cataracts is an allure basic function, it also has few favorable properties on the skin. In addition, Lutein has shown a few hostile-provoking characteristics [24]. According to research, antioxidants, In terms of protecting the skin by obstructing the harmful sky wavelengths or light, zeaxanthin has been demonstrated to have benefits similar to those of Lutein. Lutein also shields the skin from the sun's UV rays, which can harm the skin [25]. Lutein is an excellent solution for skin conditions, especially skin aging. Women (n=40) with deoxyribonucleic acid verbalization-induced rash skin sagging were given spoken zeaxanthin and restricted lutein as securing agents. Lutein is effective against blemishes, including erythema and rash, according to research conducted on rats. The damaging UVA and UVB rays of the sun can cause oxidative stress, decreased levels of carotenoids in the skin, and antitoxin, which can lead to blemishes [26].

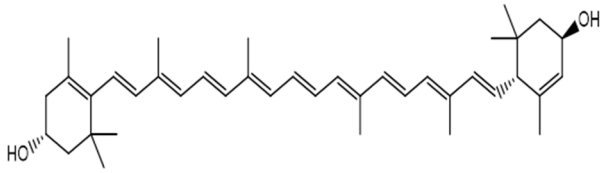


Figure 2.2. chemical structure of Lutein.

Curcumin

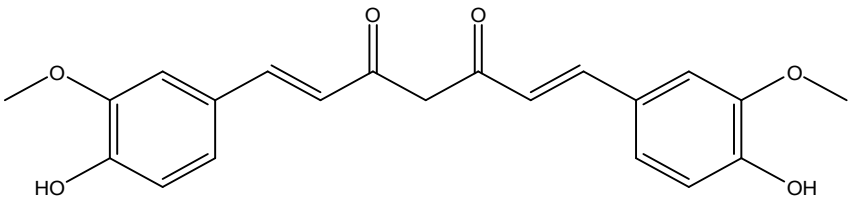


Figure 2.3. chemical structure of Curcumin.

Turmeric, or Curcuma longa, is the source of curcumin, which is considered under the ginger family of plants and is frequently used as a food spice and flavoring. Given that it comes in a vibrant tangerine-yellow treasure, turmeric is frequently used as a food color or dye in South Asia, India, and Indonesia. Turmeric contains curcuminoids that include curcumin or, undoubtedly, deferuloy methane (75 percent), dimethoxy curcumin (20 percent), and bisdemethoxycurcumin (5 percent). The popular synthetic form of curcumin is [1, 7-repeated (4-hydroxy-3-methoxyphenyl) - 1,6-heptadiene-3,5-dione]

as shown in Figure 2.3. Additionally, curcumin is used to treat a few diseases because the atom enters container coatings quickly and inquiries about a variety of goals in various container pathways [6].

A few searches identified curcumin as

1) An effective antimicrobial specialist,

2) A supplement, and

3) Having a variety of healing properties for diseased tumors, dyslipidemia, and skin infections.

Curcumin is expected to be used to treat skin problems because of its container-strengthening and checking properties [17]. Tingling is a skin condition that is a result of ongoing sensitivity and is a passionate go-between, as demonstrated by one manifestation of TNF. The current TNF production and action situation is the focus of rash that curcumin was explained restricts irritability using a subsequent constricting method that interferes with the signaling process between the allure receptor and TNF-. In addition, curcumin is powerfully effective against skin inflammation or atopic rash [7]. A curcumin cream containing turmeric oil and sandalwood oil (Vicco®) was used for radiodermatitis cases (n=50), and this study projected that curcumin could reduce radiodermatitis [26]. A review was able to assess the effectiveness of curcumin in heart disease cases (n=30), requiring 6 g/era of oral C3 curcumin. In a different study using a smaller-than-normal piglet model, curcumin was found to lessen the severity of lighted skin after 14 days of planning by guiding the skin damage and reducing the production of cyclooxygenase-2 (COX-2) and NF-B when compared to untreated skin. Curcumin is beneficial in treating wounds brought on by oxidative damage and sensitivity [27]. Reduced lipid peroxidation and reactive oxygen variety (ROS) cause curcumin to diminish and free-new combine. Because it regulates lipid peroxidation and has tumor-stopping properties, curcumin protects the skin from oxidative stress and promotes cytoprotective flagging. Curcumin primarily probes the fervent, proliferative, and redesigning phases that promote wound healing [28]. Because mPTP opening is required for curcumin-begun cytochrome C transmittal, curcumin similarly causes mPTP (mitochondrial clarity progress pore) opening, which triggers apoptosis/container passing of WM115 melanoma containers. According to a review, applying curcumin topically to mice with UVB-cued carcinogenesis can delay the onset of skin development traits like p53 and p21/Cip1-beneficial containers. Curcumin is beneficial against bacterial and animal diseases, as stated in a few studies [29].

Resveratrol

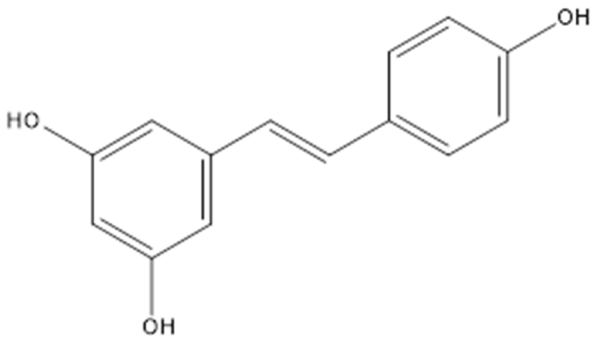


Figure 2.4. Chemical structure of Resveratrol.

It was first discovered as 3, 5, 4′-trihydroxy-trans-stilbene in about 1939. Resveratrol is a stilbenoid found in phytoalexin group as shown in Figure 2.4. Oddly, plants deliver resveratrol while also considering stressors like pests, animals, machine damage, UV radiation, and additional microorganisms that have parasitic adulteration. Resveratrol belongs to more than 70 plant classes, but despite this, it is found in grape skin the most frequently, aside from being absent from indifferent bread variations and alcoholic beverages. Resveratrol is present in both cis- and trans-isomeric forms. With the help of UV light and an extremely acidic environment, the cis-construction is isomerized from trans-resveratrol as the grape skin ages [27]. As a result of its numerous advantages, such as its ability to protect cells from oxidative stress, resveratrol is currently an important healthy supplement. The pharmacological effects include calming, antimicrobial, anti-malignant tumor, anti-ripening, and neuroprotective effects, making resveratrol a well-known formal substance for human wellbeing. Additionally, it has a high level of container reinforcements and fights off severe extreme harm by posing as a formidable extreme thief. Either outward or open skin maturation is typical. The latter is a

long-lasting change that develops based on individual histories, inherited conditions, chemicals, and correspondence. In contrast, the former is primarily caused by common factors such as poisons, lifestyle, and brightest star-based dissemination [8]. Actuated MMPs, which harm the skin's primary dignity and influence the composition of wrinkles, are a significant factor in accelerating skin ripening. Resveratrol inhibits inflammatory cytokines and MMPs verbalized by TNF through a sirtuin 1-deficient system. Reducing drooping, wrinkles, stretchiness, and dampness, resveratrol triacetate (RTA), which accounts for 0.8% of resveratrol analogs, exhibits minimal anti-crumbling activity, and by short-term resveratrol dose delays the maturation of oocytes in rodents by increasing the expression of the anti-aging gene sirtuin 1, exposing the mitochondrial function, and reducing ROS levels. By connecting to specific epidermal receptors, resveratrol shields human fibroblasts from the damaging effects of hydrogen bleach. According to research by Deloche et al., skincare products containing oligoside (4%) and resveratrol (0.5 - 1%) can improve skin flexibility and weaken wrinkles [11]. Buonocore and colleagues looked at a supplement that contained drained grape extract containing trans-resveratrol, procyanidin, punicalagin-ellagic acid, and Punica granatum, which are potent antioxidants designed for improving skin conditions as a decrease in skin roughness, increased skin moisturization. Resveratrol also lessens the expression of AP-1 and NF-B transcription factors, collagen mishap, and redness, which all contribute to the improvement of blemishes. The rational study of animals' skin is impacted by skin cancer, which develops as a result of container metamorphosis. Resveratrol has been shown to have limited chemo-preventive effects, but it does protect against UVB dissemination, which is the primary driver of non-melanoma skin cancer, by lowering COX-2 levels. UVB can increase the cyclin kinase, which enhances tumor development throughout the early stages of the malignancy incident. Due to hormonal imbalances, it occurs a small number of pathogenic factors, including Propionibacterium acnes, increased sebum production, initiating methods, and unusual follicular hyperkeratinization. However, a group of researchers have noted that by stopping Propionibacterium from replicating, resveratrol may attempt some antibacterial and antagonistic-angering properties. In other words, in accordance with various acne vulgaris situations, acne reduces the initiative response [29].

According to an old study, resveratrol-containing extract of grape seed applied topically as 2 percent lotion can heal wounds by

1) Creating a securing region in the epithelium,

2) Increasing the container bulk, and

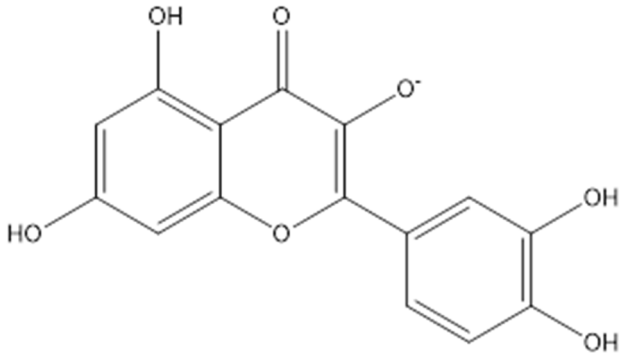
3) Enhancing the dislocation of combinational at the wound tissue area that embellishes the wound basic creation, its antimicrobial, antioxidant, and antagonistic-angering activities cause wound shortening and plug.

Other skin conditions include chloasma and melasma, which are typically characterized by uneven patches of dark to sandy color on the mandible, cheeks, nose, and above insolences. Other factors that contribute to chloasma include UV exposure, which is the main cause because it affects melanin production, historical conditions, thyroid issues, birth control method substitute therapy, and the use of photosensitizer medications [30]. According to a study, the GSE that contains pro anthocyanidin can reduce the number of melanocytes that contribute to the UV-inferred pigmentation of guinea boars' skin, which occurs as a result of the melanin being eliminated by tyrosinase in melanocytes and ROS activity.

Embelin

The plant Embelia rides, which belongs to the Myrsinaceae family, produces a substance called embelin, which has the chemical formula 2, 5-dihydroxy-3-undecyl-p-benzoquinone as shown in Figure 2.5. A polar dihydroxy-1, 4-benzoquinone ring with two carbonyl oxygen atoms is a part of the chemical structure of embelin in addition to the two vinyl hydroxyl groups. Embelin, also referred to as "False Black Pepper," is an Indo-Malaysian species that is native to South China, Malaysia, Singapore, India, and Sri Lanka [31]. Embelin has a variety of therapeutic and pharmacological effects, including analgesic, anti-inflammatory, antibacterial, antioxidant, anticonvulsant, antidiabetic, anxiolytic,

hepatoprotective, and antifertility effects. The researchers also looked at the chronic dermatitis in mice's ears that was caused by inflammation brought on by 12-O-tetradecanoyl-phorbol-13-acetate [32]. Embelin can enhance histopathological markers, reduce edema, thin the skin, lower body weight, stop neutrophil initiation, and lessen inflammatory cytokine stimulation. Polymorphonuclear leukocytes may also leave the body as a result of it. Embelin's capacity to inhibit leukocyte aggregation, suppress TNF- and IL-1, and inhibit other inflammatory factors was found to be the reason why it can lessen inflammation. The treatment of dermatitis and psoriasis may be made possible by embelin, according to this. In a dead space wound model, oral embelin increased the weight of the granulation tissue and the tensile strength, demonstrating,



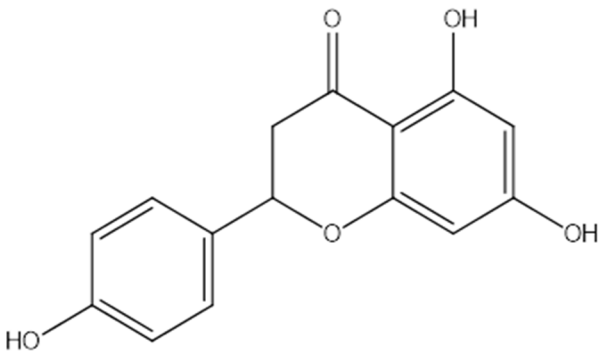
1) Enhance collagen development through the formation of cross-links between collagen fibers and

2) The presence of high protein content [33].

Figure 2.5. Chemical structure of Embelin.

Naringenin

Naringenin is found in vegetables like tomatoes and citrus fruits like grapefruits and oranges. The chemical name for naringenin is 2, 3-dihydro-5, 7-dihydroxy-2-(4-hydroxyphenyl)-4H-1-benzopyran-4-one (IUPAC name: 5.7 dihydroxy-2-(hydroxyphenyl) chromanone) as shown in Figure 2.6. Naringenin is thought to have a variety of pharmacological properties, including anti-inflammatory, anti-microbial, hepatoprotective, anti-cancer, anti-atherogenic, and antimutagenic effects, according to previous *in vitro* and *in vivo* studies. Along with gastrointestinal, rheumatological, and cardiovascular conditions, naringenin may also affect skin cancer and other skin conditions [12]. The symptoms of viral and cancerous diseases can be effectively treated with naringenin. According to earlier research, high doses of naringenin can prevent mice from developing papilloma by about 20%. Additionally, naringenin inhibits glyoxalase-1 expression, which is highly expressed in skin cell carcinomas and destroys cancer cells. Naringenin is a good option for treating skin cancer because it also suppresses the condition by increasing carbonyl content. By reducing the growth of new blood vessels present at the peritoneal and inner skin linings of mice carrying Ehrlich Ascites Carcinoma (EAC) tumors, naringenin and curcumin administration can inhibit angiogenesis activity. Naringenin also induces apoptosis, which can happen by a variety of different mechanisms, to treat human skin cancer. Collagen deterioration and an increase in MMP-1, which is produced in response to UV radiation, are two signs of skin aging brought on by UV light (photoaging). Jung and others used a culture in their research that is comparable to 3D human skin, and reported that naringenin.



1) Inhibits AP-1 and MMP-1 production brought on by UVB, and

2) Decreases MMP-13 formation and wrinkle production in a SKH1 mouse model [15].

Figure 2.6. Chemical structure of Naringenin.

All of these effects suggest that naringenin may be useful in the fight against photoaging. It also inhibits the phosphorylation of the fos-related antigen 1 (FRA1) and prevents UVB-induced extracellular signal-regulated kinase 2 (ERK2) from being produced. When exposed to UV light, naringenin lengthens the lifespan of nematodes using the Caenorhabditis elegans nematode model by suppressing the aging-regulated genes (daf-2 and age-1).

Naringenin can speed up the removal of lesions from UVB-induced cyclobutane pyrimidine dimers, suppress excessive apoptosis, and slow down the effects of UVB-induced aging [33].

Quercetin

Quercetin, a flavonoid, is present in many foods naturally, including tomatoes, ginkgo biloba, spring onions, and others. The name quercetin was derived from the Latin word quercetum, which means "oak forest" and has the molecular formula C15H10O7. Four active groups make up its structure as shown in Figure 2.7:

- the 4-carbonyl
- the C2 and C3 double bonds
- the O-dihydroxy group in the C ring
- the dihydroxy group between the A and B rings

Studies have shown that quercetin has antioxidant and anti-inflammatory properties. It also has therapeutic benefits for neurological and cardiovascular conditions, in addition to having anti-tumor, antibacterial, anti-angiogenic, antidiabetic, anti-obesity, and anti-allergic properties. Shin and others declare that [34] quercetin protects human skin from COX-2, MMP-1, and collagen deterioration brought on by UV exposure. Furthermore, because PKC-delta (PKC-delta) and Janus kinase-2 (JAK2-) are important inflammatory regulators, quercetin protects the skin from UV-induced skin aging by working on these proteins to decrease UV-induced skin aging and inflammation. Proto-oncogenes, etc. Skin cancer, which includes cutaneous melanoma, is a catch-all term for any form of cancer that develops from keratinocytes in the epidermis. By suppressing the production of cyclin D1 and MMP-2, quercetin can prevent the stimulation of STAT3 by IL-6. This prevents cell proliferation, specifically at the S and G2/M stages, where cell aggregation results in cell proliferation. In general, flavones, flavanols like quercetin and myricetin, as well as phenolic acid, are all part of the polyphenol family and have been shown to have anti-cancer properties. Shaik and other people [35] claim that quercetin inhibits the action of phosphatidylinositol-3-phosphate kinase (P13K) by inhibiting ATP binding to P13K and activating AMPK. Inhibiting B16-BL6 melanoma cell growth and DNA synthesis, postponing tumor growth, and reducing cell invasion were some of its anti-cancer properties mechanisms. In agreement with Vargas et al., [36] Quercetin is effective in treating melanoma because it can raise p53 expression. Tyrosinase and the management of ROS ultimately result in cell apoptosis and death [37]. The quality of life may be impacted by conditions of the skin like impetigo, erysipelas, folliculitis, cellulitis, and furuncles. Skin dermatitis symptoms include burning, rash, blisters, erythema, and occasionally crust formation. The two main types are contact dermatitis and atopic dermatitis, both of which result in painful, inflamed, and chronically damaged skin. According to research done *in vitro* and *in vivo* on rats, quercetin prevents the development of inflammatory cytokines and pro-inflammatory factors, which is thought to be how it reduces the severity of atopic dermatitis [38]. Its anti-allergic effect is also influenced by the upregulation of heme oxygenase, which blocks the nuclear factor erythroid 2-related factor 2 (Nrf2-mediated pathway) that leads to mast cell degranulation.

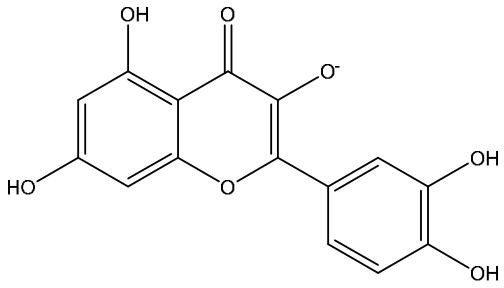


Figure 2.7. Chemical structure of Quercetin.

When quercetin and tannic acid were used to treat atopic dermatitis, the following effects were observed:

1) A decrease in T-helper type 2 (Th2) polarization; and

2) An inhibition of the cytokines thymic stromal lymphopoietin (TSLP) and thymus activate regulated chemokine (TARC). Additionally, quercetin and tannic acid inhibit neo-angiogenesis, which reduces the inflammation associated with atopic dermatitis. The inhibition of IL-6, IL-8, and TNF by quercetin

reveals its potency as a mast-cell stimulant. Quercetin also lowers cytosolic calcium levels and prevents NF-B stimulation. Because it is anti-inflammatory and antioxidant, quercetin has been shown to hasten the healing of wounds [39]. Due to the quercetin-incorporated collagen (QIC) film's promotion of cell proliferation and capacity to scavenge free radicals, it promotes wound healing more quickly than collagen-treated or control groups. Additionally, quercetin reduces the levels of uronic acid and superoxide dismutase, which lessens wound contraction and elevates hydroxyproline to improve collagen. Furthermore, quercetin works by decreasing the transforming growth factor-beta (TGF-) gene to treat keloid, an extreme dermal scar brought on by skin trauma [40].

Lycopene

Lycopene, a pigment found in plants and found in foods like tomatoes, papaya, pink grapefruit, watermelon, cloudberries, cranberries, grapes, and peaches, is one of the carotenoid family of plant pigments. Fruits' color is provided by carotenoids, which also give some fruits a distinctive scent [41]. Carotenoids give tomatoes, squash, and pumpkins their orange or red hues. The chromoplasts of plant cells contain Lycopene, which is mainly found in tomatoes and makes up to 80% of the carotenoid content. It is interesting to note that tomatoes are referred to by their scientific name, Lycopersicon esculentum. ". Numerous cis-configurations of Lycopene exist, all of which have higher thermodynamic stability. Additional stable forms include the 5-cis isomers, as well as the 7-, 9-, 11-, 13-, and 15-cis isomers as shown in Figure 2.8. Lycopene, mainly in the cis-isomer form, is present in human plasma, tissues, and breast milk. Some theories contend that the isomer type can be determined by the color of Lycopene, which is orange for the tetra-cis isomer and red for the all-trans isomer. Lycopene is a fantastic antioxidant that contains many vitamins. Due to their strong antioxidant properties, Lycopene can slow down the aging process of the skin by reducing roughness and flaking, particularly when used in conjunction with other supplements. In addition to smoothing out rough skin, the high lycopene content in the skin can also reduce the visibility of wrinkles and furrows.

In contrast to placebo, improved skin elasticity and reduced roughness Dosing with natural kale extract results in higher lycopene concentrations present in the skin than serum because the skin has an antioxidant network that helps to delay the aging process. Cosmetics containing lycopene and melatonin increase stratum corneum hydration and elasticity, which intensifies pigmentation. Each of these works to strengthen the skin's qualities and shield it from photodamage. Additionally, Lycopene is anti-cancer. Fazekas et al. [42] declare that Lycopene reduces the skin-damaging effects of UVB radiation by 5%. Lycopene has been shown to:

1) Inhibit ornithine decarboxylase (ODC) activity, which has been overly decreased during cancer development;
2) Block inflammatory responses like MPO activity and skin thickness, and
3) Induce apoptosis associated with a decrease in caspase-3 synthesis. This was confirmed by her PCNA-stained epidermal cells [42].

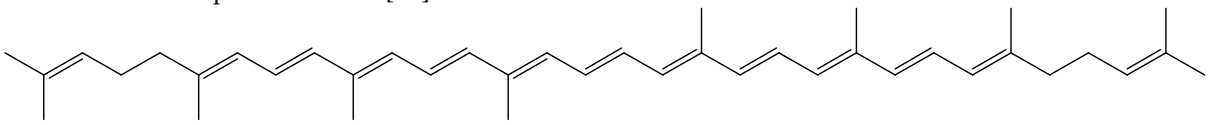


Figure 2.8. Chemical structure of L*ycopene*.

Gingerol

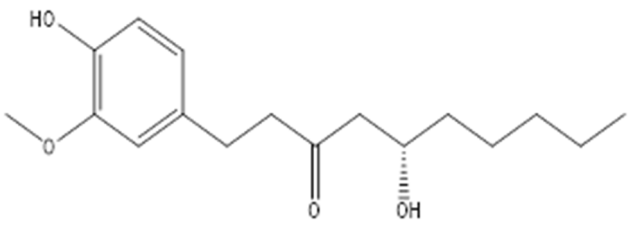


Figure 2.9. Chemical structure of Gingerol.

Ginger, which belongs to the *Zingiberaceae* family, contains the polyphenol gingerol. It is widely used as a food, a spice, and a natural remedy not just in Asia but now all over the world. The molecular formula for gingerol, also known as (5S)-5-

hydroxy-1-(4-hydroxy-3-methoxyphenyl) decan-3-one, is C17H26O4 as shown in Figure 2.9. Generally speaking, ginger has a broad range of additives, including non-volatile substances like gingerol, zingerone, parasols, and shogaols as well as volatile substances like camphene, geranyl acetate, -phellandrene, curcumene, borneol, cineole, geraniol, and linalool. The most potent ginger additive is 6-gingerol (1- [4-hydroxy-3-methoxyphenyl]-5-hydroxy-3-decanone), although 8-gingerol and 10-gingerol are also present. The skin, gastrointestinal tract, colorectal, and pancreas are just a few of the organs where gingerol exhibits anti-cancer and anti-inflammatory effects. Ginger has a potent flavor when used in high concentrations. UVB-induced ROS promotes inflammation and increases the prevalence of tumors through lipid peroxidation, DNA damage, and altered enzyme activity. Because UV is a significant cause of skin cancer, 6-gingerol helps to reduce the ROS that UVB causes.

Additionally, by preventing ROS and activating NF-B in Ha Cat cells by preventing I phosphorylation, 6-gingerol lowers the amount of COX-2 that is created when UVB exposure is present. Thus, apoptotic pathways brought on by UVB are suppressed. In reality, COX-2 plays a key role in preventing photo inflammation, the main factor in tumorigenesis and photoaging. By inhibiting the p38 mitogen-activated protein (MAP) kinase NF-B signaling pathway, gingerol further demonstrated ginger's anti-tumor effects [43].

Apigenin

Apigenin, a member of a flavone class, is the aglycone of several natural glycosides. The aglycic form of apigenin, as well as its C- and O-glucosides, glucuronides, acetylated derivatives, and O-methyl ethers, are present in species like *Labiatae,* the chemical formula C15H10O5 and a molecular weight of 270.24, apigenin, also known as 4', 5, 7, -trihydroxyflavone, is a flavonoid as shown in Figure 2.10. The Biopharmaceutical Classification System (BCS) states that mugwort, matricaria, Achillea, and tanacetam are the primary apigenin sources. Additionally, plant-based beverages like beer, herbs like thyme, basil, chamomile, and oregano, as well as vegetables like celery, parsley, and onions, all contain glycosylated forms of apigenin. Other foods that contain apigenin include oranges, white and red sorghum, wheat sprouts, suede, coriander, and kumquats. Excellent biological properties such as antioxidant, anti-tumor, anti-allergic, anti-inflammatory, neuroprotective, and antibacterial are present along with its low content. Topical apigenin has been demonstrated to be effective in skin conditions like atopic dermatitis associated with the reduced permeability barrier. It can enhance the homeostasis of permeability barriers, as well as boost the levels of mRNA, lamellar bodies, and the synthetic lipid enzyme filaggrin. The anti-inflammatory properties of Apigenin ointment, according to some reports, suggest that it may lessen dermatitis and eczema [44].

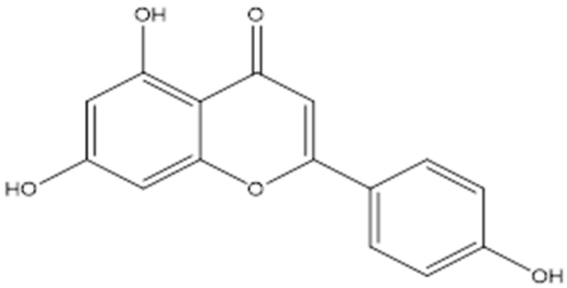


Figure 2.10. Chemical structure of Apigenin.

Polyphenols and skin photoprotection polyphenols

Dietary polyphenols, especially those with anti-inflammation, immunomodulation, and antioxidative properties, are some of the most promising compounds to use as ideal chemopreventive agents for various skin diseases in general and skin cancer in particular. As a result of recent advancements in our comprehension of carcinogenesis at the cellular and molecular level, promising cancer prevention methods, or so-called "chemoprevention" strategies, have been developed. Chemoprevention is a strategy that uses particular organic or inorganic chemicals to stop the growth of cancer. Chemopreventive strategies seem to be beneficial for reducing the risk of skin cancer. Unlike environmental carcinogens, which are difficult to control, changes to a person's diet and lifestyle can be made with caution. Studies done in our lab show that naturally occurring polyphenols, like green tea polyphenols (GTP), silymarin derived from milk thistle, and grape seed proanthocyanins (GSP), inhibit UV-induced inflammation, oxidative stress, DNA damage, and immune responses (Figure 3). We

briefly review and discuss the photoprotective potential of several polyphenols in this article, including grape seed polyphenols and polyphenols from green tea and its mechanism of action as mentioned in Table 1.

Table 1. Various polyphenols with their sources and its mechanism of action.

Polyphenols	Source	Molecular target/ mechanism
Catechins	Tea leaves and buds	Inhibits COX-2, PGs, IL NF-j B, IK Ka, AP-1, MAPK proteins, H2O2, NO, iNOS, LPO, MPO inflammation, and MAPK proteins. It also enhances the antioxidant defense enzyme and inhibits DNA damage repair mechanisms.
Proanthocyanidins	Grape seeds, nuts and bark	Antioxidant defense enzyme Inflammation Inhibition of H2O2, iNOS, LPO, and MPO NF-jB, IKKa, and AP-1 proteins.
Resveratrol	Grape skin, peanuts, red wine, mulberrie	Use in inflammation throgh inhibition of NF-jB, IKKa, AP-1, and MAPK proteins, as well as an antioxidant defense enzyme.
Silymarin	Milk thistle	Inhibits the production of H2O2, LPO, NO, iNOS, MPO, COX-2, PGs, PCNA NF-j B, IK Ka, AP-1, and MAPK proteins, which are involved in the cell cycle.

Herbal plants in photo protection and sun screening action

Herbal Ingredients: Sunscreens

Phyllanthus Emblica (Family – Phyllanthaceae)

These fruits are high in ascorbic acid (vitamin C) and contain a mixture of minerals, amino acids, calcium, iron, carotenes, Phyllanthin, flavonoids, and polyphenols such as kaempferol. Due to the presence of Phyllanthus, aqueous extract exhibits a free radical effect. Effectively decreases the generation of peroxide free radicals (Table 2). For this reason, it exhibits a protective effect against the transmission of ultraviolet rays [45].

Luffa cylindrica Family - cucurbitaceae)

It is classified as a type of cucumber. Loofah is a subtropical plant. They have triterpenoid saponins such as luciosides A, B, C, D, E, FE and ginsenosides. The leaves contain triterpenoid saponins such as lucyosides G, P, N, O, and Q; it contains polypeptides and also contains various antioxidants that have a nourishing effect on the skin. Seed oil is used to treat skin problems such as erythema, sunburn, and red pigmentation [46].

Green Tea (Family Camellia sinensis)

Green tea leaves have antioxidant properties. Antioxidants are compounds that protect cells from the lethal effects of reactive oxygen species (ROS), such as superoxide, oxygen, and hydroxyl radicals. The penetration of ultraviolet rays forms it. The basic chemical constituents of green tea include catechins, vitamin E, tocopherols, carotenoids, and polyphenolic compounds, which are said to exhibit powerful antioxidant properties and are used as herbal sunscreens [47].

Purslane (Portulaca oleracea Family- Portulacaceae)

They have omega-3 fatty acids, eicosapentaenoic acid (EPA), mainly vitamins (vitamins A, C, E, and B), alpha-linolenic acid, and some carotenoids. Basically, alkaloid pigments exist. Both reddish betacyanin and yellow betaxanthin are pigments and have been found to be potent antioxidants and antimutagenic [48].

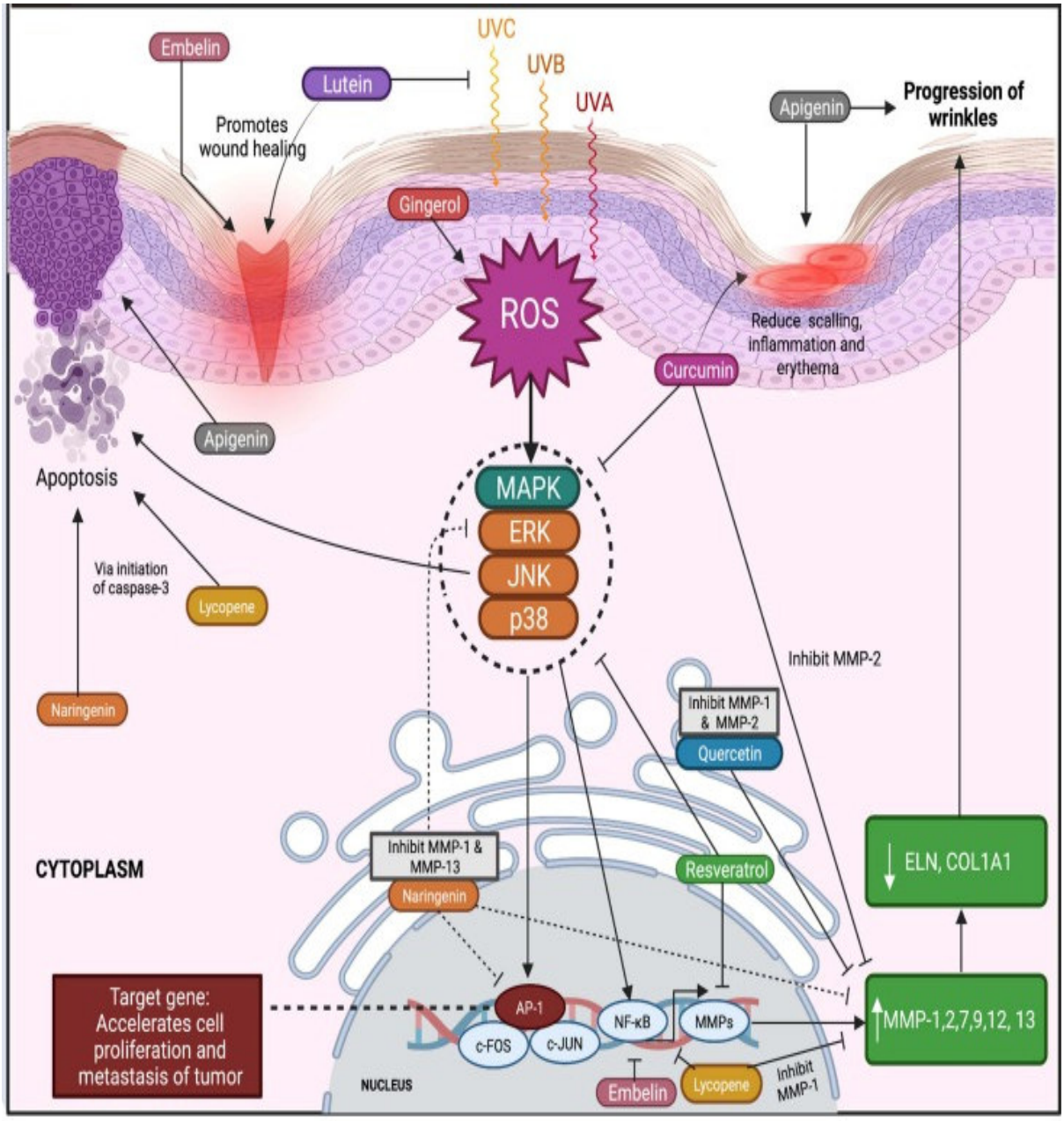


Figure 3. Overall mode of action for natural products against skin disorder.

Tomato (Solanum lycopersicum Family-Solanaceae)

Tomatoes are widely available and consumed everywhere. One of the most potent naturally occurring antioxidants, carotene-lycopene, is primarily present in them. Additionally, lycopene has been found to enhance the skin's capacity to defend itself against damaging UV rays. The natural antioxidants anthocyanins, pantothenic acid, and cryptoxanthin are all present in tomatoes, along with vitamins A, C, and E. It has. Tomatoes have strong defenses against neurodegenerative diseases and block UV rays because of the presence of these components [49].

Carrot (Dacus carota Family- Apiaceae)

They have carotenoids, mainly β-carotene, that effectively scavenge free radicals, especially singlet oxygen, superoxide anions, and hydroxyl radicals. Other ingredients are present in carrots, i.e., oxyacetylene, omega 3, 6, and 9. Carrot seed oil, stigmasterol, beta-sitosterol, vitamin A, and

campesterol effectively improve the body's immune response to UV rays, nourish and rejuvenate the skin, and exhibit cytotoxicity to mutagens [50].

Table 2. The overall mode of action for natural products against skin disorder.

Name of phytoconstituents	Biological source	family	Part used	MoA
Mangiferin	Mango	*Anacardiaceae*	Leaves	**Skin aging is reduced** By expanding the collagen fibers in the skin. Inflammation Reduction (dermatitis and psoriasis) is achieved by suppressing ERK and JNK pathway, as well as by inhibiting the MEK and SEK pathways. By reducing inflammatory mediators and inflammatory biomarkers, which in turn inhibits the inflammatory activity via a CD68 activity inhibitor. **wound recovery** By promoting the fibroblasts' migration and cell division while suppressing MPO activity by raising the Nr f- 2 degree, which reduces oxidative damage to skin tissue regenerative skin flaps. **Treatment of skin cancer** Through inhibiting expression of IL6, TNF, PLAU, KDR, IFNGT, FGFI, and PGF as well as fibroblast growth factor.
Lutein	**Marigold flowers**	*Anacardiaceae*	Flower	**Decrease skin aging** by improving colour, luminosity, and skin tone by protecting against gene expression and offering the skin a barrier against UVR. Stop skin damage and strengthen skin's component. And Enhance the reduction of inflammation (psoriasis and skin erythema) and the collagen I/elastin aging index. By blocking UVR, you can lessen skin rashes due to antioxidant activity. Reduce the proliferation of epidermal cells and the number of sunburned cells. **Skin cancer treatment** by reducing the chance of SCC. Reduce the size and frequency of tumours while increasing the time spent cancer-free. By boosting the hyaluronan production.
Curcumin	Turmeric	*Zingiberaceae*	Dried roots	**Decrease in inflammation** By preventing the growth of human keratinocytes. Through preventing the expression of IL-Ib and IL-6 that TNF-a causes. Reduced symptoms of dermatitis. By lowering radiodermatitis. By preventing PKC from being phosphorylated, alter the protein kinase pathway. Wound healing. By lowering reactive oxygen species (ROS) and lipoid peroxidation. Create a protective effect.
Resveratrol	**Red grapes**	*Vitaceae*	Fruits	**Decrease skin aging** by preventing inflammatory cytokine and MMP expression that is brought on by TNF. By promoting mitochondrial function, increasing sirtuin I expression, and reducing ROS generation**.**
Embelin	**Embelia ribes,**	*Myrsinaceae*	fruits	**Skin cancer treatment** by reducing the occurrence of papilloma's. By reducing the prevalence of papilloma's. By reducing the size and quantity of p. by glyoxalase-1's expression being expressed less. Increased carbonyl content. Peritoneal and inner skin linings produced fewer new blood vessels. Induced apoptosis, which included. **Accelerating aging of skin** Through preventing the UVB-induced MMP-1 and activator protein-1 (AP-1) production. By preventing the synthesis of NF- K b and MMP-13, both of which cause wrinkles.
Naringenin	Grapes	*Vitaceae*	fruits	**Minimize skin aging** by preventing the human skin's natural COX -2, and collagen breakdown from being stimulated by UV light. By preventing AP- I and Nf –Kb stimulation. **Skin infection treatment.**

				Can prevent some pathogens. Defend against H. pylori infection as well as MRSA. Reduction of inflammation. By suppressing cytokines that cause inflammation and proinflammatory factors. Heme oxygenase is being upregulated.
Quercetin	Onions	*Liliaceae*	Bulb	**Skin aging be reduced** by lessening the scaliness and roughness of human skin. By making the skin more elastic. By increasing the skin's hydration and stratum corneum elasticity. **Treat skin cancer** By reducing the production of caspase3 and stifling ODC activity, inflammatory responses like MPO activity and skin thickness are blocked. **Inflammation reduction** by lessening the sensitivity to erythema brought on by UV radiation
Lycopene	Tomato	*Solanaceae*	fruits	**Reduce the skin aging process** by lessening human skin's scaliness and roughness. By increasing the skin's elasticity. By increasing the stratum corneum's elasticity and moisture content. Deal with skin cancer. By reducing the production of caspase3 and stifling ODC activity, inflammation-related responses like MPO activity and skin thickness are blocked. **Reduction of inflammation** by lessening the sensitivity to erythema brought on by UV radiation.
Gingerol	Ginger	*Zingiberaceae*	roots	**Treatment of skin cancer** Through decreasing the UVB – induced ROS. Through suppressing the UVB – induced COX– 2 productions Exert chemoprotective effect by targeting the arachidonic acid pathway. Through suppressing the melanin formation and by inhibiting melanogenesis development. **Treatment for skin cancer** through a reduction in UVB-induced ROS. By reducing COX- 2 production that is caused by UVB exposure. Chemoprotective effects by focusing on arachidonic acid pathway. Throgh preventing the development of melanogenesis and suppressing the melanin production.
Apogenin	Matricaria chamomilla	-	Flowers	**Treatment of skin cancer** Through stimulating the AMP-activated protein kinase and by inhibiting proliferation of the cell and also development of cell cycle. By suppressing Akt and Mtor signalling Inflammation reduction. By reducing the inflammation causing cytokines due to TSP I. **Reduce aging of skin** By reducing skin roughness and improving the fine lines and wrinkles due to antioxidants activity treatment for skin cancer. Through AMP-activated protein kinase stimulation and inhibition of cell proliferation and cell cycle development. Akt and Mtor signalling is being blocked. **Reduction of inflammation.** By lowering the TSP-related inflammatory cytokines, I. **Reduce the aging process of the skin** Due to the activity of antioxidants, skin roughness is reduced, and fine lines and wrinkles are improved.

Manjistha (Rubia cordifolia Family - Rubiaceae)

Manjistha is another name for Indian madder. The major chemical constituents of Indian madder include pseudopurpurin, mundistin, proxanthin, flavonoids, free alizarin, and glycosides. These ingredients are reported to have beneficial effects in treating skin conditions such as uneven pigmentation, hyperpigmentation, allergies, eczema, and sunburn and improve skin tone [51].

Aloe Vera (Aloe Vera Family – Xanthorrhoeaceae)

The aloe vera plant is a wonderful one that contains minerals, vitamins (A, C, and E), amino acids, enzymes, polysaccharides, palmitic acid, oleic acid, caprylic acid, stearic acid, and beta-sitosterol. Aloe vera is used in facial tissues as a moisturizer, soap, sunscreen, and tanning agent. Radiation-induced skin damage is avoided by topically applying aloe vera. Aloe has a high concentration of antioxidants, which work to combat the unstable compounds known as free radicals and have positive effects on UV absorption. There is evidence that Aloe is effective in healing and that it also strengthens the immune system. It serves as both an astringent and an antipruritic [52].

Walnut (Juglans Regia Family – Juglandaceae)

Amino acids, carbohydrates, and unsaturated fatty acids are the main components of walnut seeds. Polyunsaturated fatty acids, linolenic and linoleic acids, glyceryl triacylate, and antioxidants are all abundant in walnut oil. Its aqueous extract has been shown to be a reliable self-tanner. The keratin protein in the skin has reportedly been impacted by its primary chemical component, juglone. Walnuts also provide UV protection [53].

Damask rose (Rosa damascene Family - Rosaceae)

This flower is famous for its delicate scent used in perfumes and cosmetics. The chemical composition of rose oil is one of the most complex. Basically, it contains citronellol, geraniol, nerol, stearpotene, phenylethanol, and trace amounts of nonanal and linalool. A cream or lotion mixed with rose oil. Stimulates and hydrates skin while moisturizing, beneficial for dry, mature, and sensitive skin. It reduces redness, reduces inflammation, and helps repair broken veins in the skin. It has been reported to be effective in preventing the penetration of ultraviolet rays [54].

Lemon (Citrus limonum Family- Rutaceae)

Extracted from lemon fruit is lemon oil. Lemon oil is watery in consistency, pale greenish-yellow in color, and has a strong, fresh scent. The primary chemical components of lemon oil, such as linalool, -bisabolene, nerol, camphene, -pinene, sabinene, myrcene, and ascorbic acid, have potent antioxidant properties. Lemon oil has several uses, including treating acne, cleansing oily skin and hair, removing dead skin cells, and soothing sunburned skin. The citrus limonum (Rutaceae) family's fruit is used to produce lemon oil. Lemon oil has a strong, clean scent and is watery in consistency. It is a light shade of greenish yellow. Linalool, -bisabolene, nerol, camphene, pinene, sabinene, myrcene, and ascorbic acid are the main chemical components of lemon oil and have powerful antioxidant properties. In addition to treating acne, cleaning oily skin and hair, removing dead skin cells, and soothing sunburned skin, lemon oil has many other uses [55].

Apple (Malus domestica Family-Rosaceae)

Various phytochemicals with unknown nutritional value and potential antioxidant activity in vitro can be found in apple peel. Apples contain a variety of flavonoids, including procyanidin B-2, epicatechin, quercetin, and epicatechin, as well as other phenolic phytochemicals [56].

Turmeric (Curcuma longa Family - Zingiberaceae)

A perennial herbaceous plant with rhizomes, turmeric belongs to the *Zingiberaceae* genus. The curcuminoids, which include curcumin, desmethoxycurcumin, and demethoxycurcumin, are the primary chemical components of turmeric. In addition, there are other significant essential oils like zingiberene, atlantone, and turmeric. Curcuminoids aid in the defense of skin cells against oxidative damage. Scavenging hydroxyl radicals is a powerful function of it. It exhibits UV and is regarded as the most reactive oxidant [57].

Rose root (Rhodiola rosea Family- Crassulaceae

Rhodiola rosea is a plant that grows naturally in the cold regions of the world. Scientists have identified about 140 compounds in the subterranean part. They include phenols, rosavins, rosins,

organic acids, terpenoids, phenocarboxylic acids, flavonoids, anthraquinones, and alkaloids. There are many other phenolic antioxidants, such as proanthocyanidins, quercetin, gallic acid, chlorogenic acid, and kaempferol. Due to the presence of the above chemical components, it has been reported to be effective in suppressing ultraviolet rays [58].

Oil as Sunscreens

Researchers have found that many oils originate from herbal source and have been reported to block UV ray penetration and shows sun screening action.

Sesame oil (Sesamum indicum Family- Pedaliaceae)

Sesame oil has been used as a medicinal oil for thousands of years. *In vitro*, sesame oil inhibited the proliferation of prostaglandins and leukotriene in malignant melanoma (a type of skin cancer). It has strong antioxidant properties. In the tissue under the skin, this oil neutralizes free oxygen radicals. Contains palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid and eicosenoic acid. Sesame oil is rich in Vitamin E [59].

Olive oil (Olea europaea Family- Oleaceae)

A fat derived from the olive fruit. Olive oil is composed of triglyceride esters of oleic and palmitic acids and trace amounts of squalene and sterols (phytosterols and tocosterols). It also contains polyphenols such as tyrosol and hydroxyl tyrosol esters, including oleocanthal and oleuropein. Several types of flavonoids and lignans are also present. Olive oil has a long tradition as a home remedy for skin care. Squalene is used as an antioxidant, a moisturizer, and as a convenient vehicle for carrying other substances in topical sunscreen formulations [60].

Castor oil (Ricinus communis Family-Euphorbiaceae)

Vegetable oil made from castor beans is known as castor oil. It is clear to light yellow liquid. Ricinoleic acid makes up 90% of the fatty acid chain in this triglyceride. Other significant compounds include oleic and linoleic acids. Ricinoleic acid, a monounsaturated fatty acid with 18 carbons, is a fatty acid that is commonly found in castor oil. All skin issues benefit from castor oil's ability to relieve a variety of issues, including elastin, which aids in skin healing, softens, and moisturizes [61].

Argan Oil (Argania spinosa)

Vegetable oil, known as "argan oil," is obtained from the argan tree's fruit. Because of its numerous medicinal, cosmetic, and nutritional benefits, it is highly prized. Contains phenols, carotenes, squalene, tocopherols (vitamin E), and fatty acids. Catechins, caffeic acid, oleuropein, vanillic acid, and tyrosol are the primary natural phenols found in argan oil. Traditional uses for unroasted argan oil include treating skin issues and using it as a skin beauty oil. According to reports, it offers antioxidant, UV Protection, moisturizing, and nourishing advantages [62].

Sunflower Oil (Helianthus annuus)

Sunflower seeds are used to press non-volatile sunflower oil. It serves as a softening agent in cosmetics. Most of its ingredients are MUFA, PUFA, omega 9, omega 6, vitamin E, squalene, palmitic acid, and stearic acid. Additionally, lecithin, tocopherols, carotenoids, and waxes are found in sunflower oil. It shields your skin from damaging UV rays while maintaining moisture [63].

Borage seed oil (Borago officinalis)

Vegetable oil, known as "argan oil," is obtained from the fruit of the argan tree. It has many medicinal, cosmetic, and nutritional benefits that are highly valued. They have fatty acids, phenols, carotenes, squalene, tocopherols (vitamin E), and carotenes. Catechins, caffeic acid, oleuropein, vanillic acid, and tyrosol are the primary natural phenols found in argan oil. Traditional uses for unroasted argan oil include the treatment of skin conditions and use as a skin-beauty oil. According to reports, it has antioxidant, UV protection, and moisturizing properties [64].

Evening primrose oil (Oenothera glazioviana Family- onagraceae)

Evening primrose oil is derived from the seeds of the Oenothera glazioviana plant. The term "evening primrose" is frequently used because many species of flowers bloom in the evening. It is encouraged to use evening primrose oil in UV radiation-induced cancer treatments. There is linolenic acid, which has antioxidant properties [65].

Avocad oil

Monounsaturated fats and vitamin E are abundant in it. The absorption of carotenoids and other nutrients is improved by avocado oil. Since it quickly absorbs and has a very high skin penetration, it is initially extracted for cosmetic purposes. It is a potent oil that penetrates very deeply and is rich in potassium, lecithin, and vitamins A, D, and E [66].

Future Perspectives

- Combination Therapies: Exploring the Synergistic Effects - Future research could focus on investigating the potential synergistic effects of combining different natural products in the treatment of skin disorders. Understanding the interactions and cooperative mechanisms between various compounds can lead to the development of more effective therapeutic strategies [4].
- Nanotechnology for Enhanced Delivery - Utilizing nanotechnology to enhance the delivery of natural products to the skin holds great promise. Nanocarriers can improve the stability, bioavailability, and targeted delivery of active ingredients, allowing for better penetration and efficacy in treating specific skin conditions.
- Personalized Skincare - Advancements in genomic and proteomic research can pave the way for personalized skincare approaches. By understanding individual variations in gene expression and protein profiles, tailored treatment plans can be developed, considering the specific needs and characteristics of each person's skin [13].
- Combination Therapies: Exploring the Synergistic Effects - Future research could focus on investigating the potential synergistic effects of Clinical Trials and Standardization - Conducting rigorous clinical trials with larger sample sizes and diverse populations is crucial for establishing the efficacy and safety profiles of natural products. Moreover, standardization of extraction methods, dosage forms, and quality control measures is essential to ensure consistent and reliable results across different products.
- Exploring Unexplored Natural Sources - There is a vast array of natural sources that have not been extensively studied for their potential in skincare. Future research should focus on exploring lesser-known plant extracts, marine-derived compounds, and other natural sources to uncover novel bioactive ingredients with therapeutic benefits for various skin disorders [18].
- Sustainable and Ethical Practices - With increasing awareness of environmental sustainability and ethical considerations, future studies should emphasize the development and utilization of natural products obtained through sustainable sourcing, organic farming practices, and fair-trade agreements. This approach ensures the preservation of biodiversity and supports local communities involved in the production of these natural ingredients.
- Mechanistic Studies - In-depth mechanistic studies are needed to elucidate the precise molecular pathways and targets involved in the therapeutic effects of natural products. Understanding these mechanisms will not only enhance our knowledge of their mode of action but also aid in the development of more targeted and specific interventions [25].

By pursuing these future perspectives, the field of natural product-based skincare can continue to evolve, providing innovative and effective solutions for various skin disorders while prioritizing sustainability, safety, and personalized care.

Conclusion

In conclusion, this review article comprehensively explores the role of natural products in the treatment and management of various skin disorders. The skin, being the largest organ of the body, is

exposed to numerous external factors that can lead to inflammation, hyperproliferation, and infection. Dysregulations in the skin-associated lymphoid system further contribute to these conditions, emphasizing the importance of controlling immune responses in maintaining skin health. Throughout the review, the action and mechanism of action of several natural products have been discussed, highlighting their potential effectiveness against skin disorders. Compounds such as mangiferin, lutein, curcumin, resveratrol, embelin, naringenin, quercetin, lycopene, gingerol, and apigenin, among others, have demonstrated promising therapeutic properties. Moreover, the review sheds light on the significance of polyphenols in skin photoprotection, elucidating their sources and mechanisms of action. Herbal plants have shown immense potential in enhancing photoprotection and acting as natural sunscreens. Ingredients like Phyllanthus Emblica, Luffa cylindrica, Green Tea, Tomato, Carrot, Manjistha, Aloe Vera, Walnut, Damask rose, Lemon, Apple, Turmeric, Rose root, and various oils like Sesame oil, Olive oil, Castor oil, Argan Oil, Sunflower Oil, Borage seed oil, Evening primrose oil, and Avocado oil have been explored for their sun screening properties. Moving forward, future perspectives in this field hold great promise. Combination therapies involving natural products could be explored to harness synergistic effects and enhance treatment outcomes. Nanotechnology can play a crucial role in improving the delivery and efficacy of natural products. Personalized skincare approaches based on individual genetic and proteomic profiles can lead to tailored treatment plans. Furthermore, rigorous clinical trials, standardization of extraction methods, and quality control measures are essential for establishing the safety and efficacy of natural products. Exploring unexplored natural sources and conducting mechanistic studies will provide a deeper understanding of the therapeutic mechanisms and uncover novel bioactive ingredients.

Finally, ethical and sustainable practices should be prioritized to ensure the preservation of biodiversity and support local communities involved in the production of natural ingredients. In conclusion, this review highlights the potential of natural products in addressing skin disorders and lays the foundation for future research and development in this field. By harnessing the power of nature, we can continue to advance our understanding and utilization of natural products for the benefit of skin health and overall well-being.

Acknowledgements

None

Authors contribution

All the authors have contributed equally.

Declaration of interest

The authors declare no conflict of interest.

Financial support

This work has not received any funds from national and international agencies.

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How to cite this article:
Maurya SK, Divakar S, Patil UK. Potentials of plant derived products for the treatment of skin disorders. German J Pharm Biomaterials. 2022;2(3):9-31.