IJD Review Article

Application of Indian medicinal herbs for skin problems following safety measures against COVID-19

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Received: 19 June 2020
Accepted: 26 July 2020

The daily work plan of the human has changed dramatically due to the spread of the coronavirus disease 2019 (COVID-19) pandemic. The viral infection was first detected in Wuhan, China, and was first transmitted via the bat as a zoonotic disease that was confirmed in December 2019. On 30th January 2020, this viral outbreak was declared a public health emergency or epidemic. Subsequently, on 11th February 2020, the World Health Organization (WHO) declared it a pandemic. The potentially lethal virus has become a threat to the global population. The WHO provides special precautions and instructions to people all around the world, among which the importance of wearing a face mask, gloves, and a head protector are discussed. Many healthcare workers (especially doctors and nurses) and common people suffer from skin infections with the use of a continuous face mask, gloves, or other protective items. In order to alleviate skin dermatitis, it is important to use well-known natural herbals in the search for new drug sources. It is advisable to use useful herbal extracts in sole or in combination as cosmetic products for the treatment of skin diseases. India is a focal point of medicinal plants. Many Indian herbal plants are essentially used as cosmetics to cure skin infections. Natural herbs are safe, non-toxic, and cost-efficient for treating skin dermatitis during the COVID-19 situation.

Keywords: COVID-19, dermatitis, herbals, PPE, skin problems, treatment

IranJDermatol2020;23(Supp.1):S24-37

DOI: 10.22034/IJD.2020.120510

INTRODUCTION

The coronavirus isn't new to the world. It was first identified in the 1960s as a cause of upper respiratory tract infections in children. Since then, a number of novel coronaviruses have been identified, among which is the severe acute respiratory syndrome coronavirus (SARS-CoV), which was recognized in 2003; this beta-coronavirus caused substantial morbidity and mortality [1]. Thereafter, a new coronavirus gave rise to a disease in the Middle East in 2012 that caused around a thousand deaths, which the World Health Organization (WHO) named as the Middle East respiratory syndrome coronavirus (MERS-CoV) [2]. Recently, a novel coronavirus outbreak from China's Wuhan city was initiated at the end of the year 2019, with the infection rapidly spreading to the wider Chinese community within a few days [3]. Following several investigations, this novel coronavirus infection has been confirmed as a zoonotic infection that spread from the bat to the human being, with genetic similarity to the human coronaviruses 229E and NL63 found in bats [4]. Initially, Chinese researchers referred to the virus as the Wuhan coronavirus or 2019 novel coronavirus. Finally, the International Committee on Taxonomy of Viruses (ICTV) renamed the virus as the severe

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acute respiratory syndrome coronavirus-2 (SARS-CoV-2), with the related coronavirus disease 2019 (COVID-19) becoming a worldwide pandemic [5].

The structure of the SARS-CoV-2 contains a nuclear portion, i.e., a single-stranded RNA (length of between 26 to 32 kbs) [6]. The novel coronavirus (Family: *Coronaviridae* with the order, *Nidovirales*) is named according to the crown-like spikes on its outer surface and has a size range of 65–125 nm in diameter. The basic mechanism of infection is related to the spikes, which consist of glycoproteins. The spikes attach to the host cell membrane and progressively crawl down to the bronchial tubes. Ultimately, the virus enters the lungs, and the pulmonary mucous membranes gradually become inflamed. This causes damage to the alveoli or lung sacs, causing an inadequate supply of oxygen to the blood, which gradually chokes the heart and ultimately results in death. The three primary modes of transmission of this virus are respiratory, aerosol, and touch transmission. A key method of transmission is through contact, by which the novel virus has spread to most countries across the globe. This involves droplets that form as an infected person sneezes, together with close contact with the infected person and frequent touching of the face in public places. The virus is now spreading uncontrollably and causing the death of hundreds of thousands of humans worldwide. The number of COVID-19 patient deaths has spiked to more than 425,000 worldwide until June 14, 2020, with America having the highest number of deaths followed by Europe and Asia. As of June 14, 2020, COVID-19 has caused the largest number of human deaths among the Asian countries in India.

The basic symptoms such as fever, cough, shortness of breath, etc. are found in infected patients. Notably, the widespread usage of antibiotics results in the development of resistance against SARS-CoV-2. Consequently, asymptomatic patients have recently become more numerous, facilitating the increased spread of the virus. Governments also take drastic steps to prevent the spread of the disease, but the virus is highly mutated, as a result of which there is still a lot of uncertainty about how the virus works and evolves within the host bodies, and researchers still find it difficult to develop a particular drug or vaccine. The discovery of new drug molecules that are effective against COVID-19 is blocked by a number of obstacles; some medicines and vaccines have reached phase II clinical trials but will take a while to become available on the market.

Common protective measures against COVID-19

Many healthcare professionals (mostly doctors and nurses) serve endless efforts for the treatment of COVID-19. They are continuously under full body protection as per WHO guidelines and governmental orders on using personal protective equipment (PPE). Importantly, PPE coats the skin and clothes and completely protects mucous membranes when delivering patient care [7]. The PPE consists primarily of masks, gloves, hooded caps, face shields, goggles, gowns, shoe covers, and towels. Special care must also be taken against skin dermatitis because the body is completely protected with safety helmets, protective hats, gloves, eye goggles, high-visibility clothing, safety footwear, and safety harnesses. It is mandatory to wear a mask and gloves, and hand sanitizers (75% alcohol) must be used frequently as per the directions of the WHO [8]. All over the world, the 'lockdown' concept has been used at times to minimize social contact and to curtail the spread of the novel coronavirus. Obviously, social distancing, use of folded elbows during sneezing, wearing medicated face masks, avoiding to spit in public places, avoiding to frequently touch the face, using alcohol-based hand sanitizers, using chlorine or UV disinfection, and taking a hot water bath at 56 °C are some guidelines that people need to obey to receive special security against SARS-CoV-2 infection. In fact, the SARS-CoV-2 is a very egoistic virus; it can only infect a person if he or she does not maintain these proper precautions and conditions of self-hygiene.

Effect of excessive usage of protective measures on skin

Several researchers, including dermatologists, are reporting the occurrence of acute and chronic skin disorders (erythema, papules, maceration, and scaling), secondary infections, and aggravation of existing dermatitis by the excessive use of PPE [9]. Moisture-induced skin damage and skin tears over the whole body are the main injuries caused by the prolonged donning of PPE. The key areas

affected are the nasal bridge, hair, cheeks, forehead, and hands, where further protection is needed because the virus enters through the nose tubing, mouth, or eyes [10]. Vertical pressure is generated with the prolonged use of PPE, causing delayed pressure urticaria [11]. In addition, nonporous PPE is airtight and prolonged usage may cause difficulty breathing and skin barrier dysfunction followed by skin dryness, redness, formation of scales, and itching due to the closed and moist environments surrounding the body [8] (Figure 1). Not only this, but PPE also induces extreme discomfort, tiredness, and exhaustion. Constant use of hand sanitizers and water also causes skin irritation [12]; even the repeated application of latex gloves on the hands causes occlusion and epidermal cell hyper-hydration, resulting in erosions and maceration [8], i.e., skin whitening, softening, and wrinkling (Figure 2), and even hand eczema [13]. In one study, over 300 healthcare employees were screened for skin damage and about 70% of them had been affected by skin barrier damage with signs of scratching, burning, erythema, dryness, stinging, and maceration [8]. Continuously wearing face masks and goggles also causes urticaria, contact dermatitis, skin dryness, and worsening

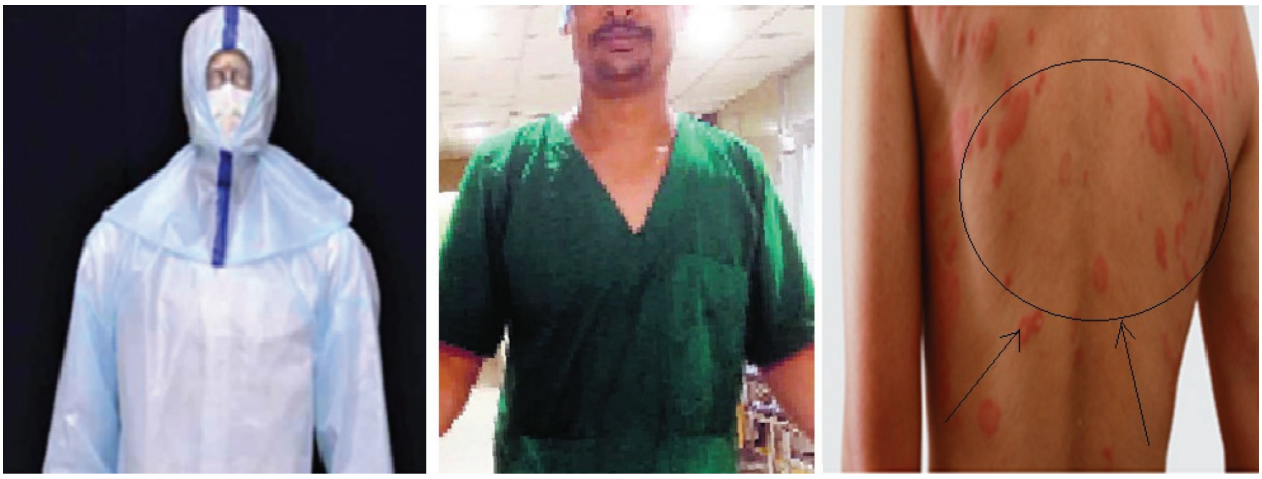

Figure 1. Wearing of PPE by healthcare workers and its side effect.

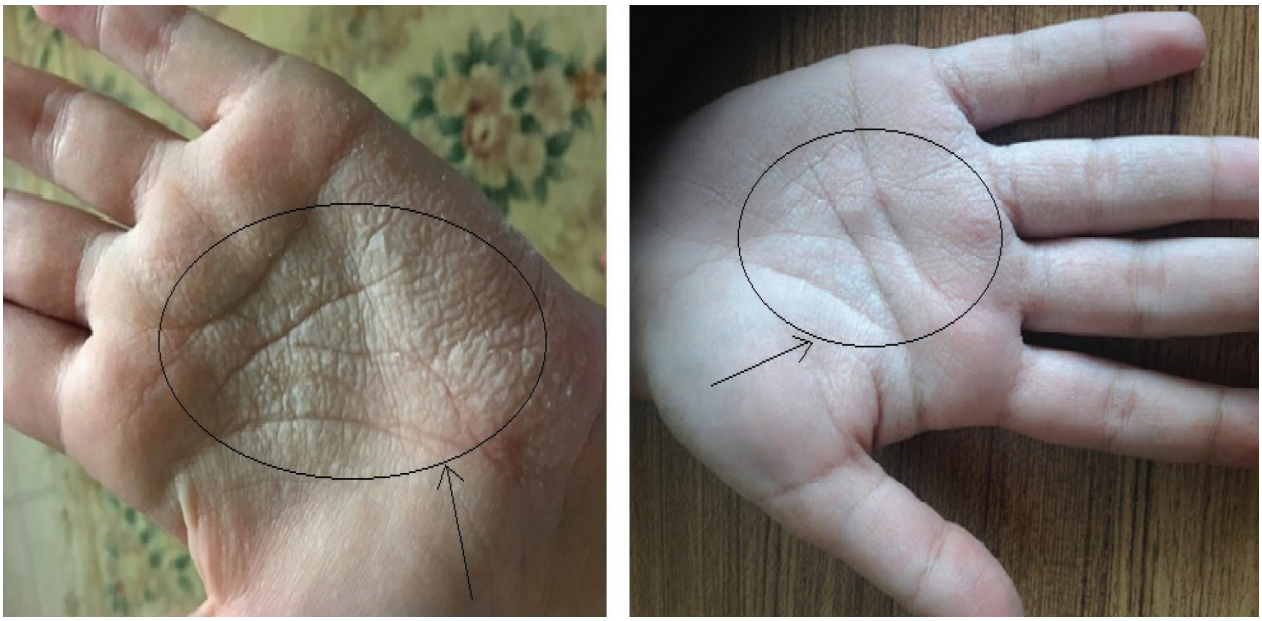

Figure 2. Macerated skin with whitish and wrinkled appearance due to wearing of gloves during the COVID-19 pandemic.

Figure 3. Skin problems due to use of face mask during the COVID-19 pandemic.

of existing skin diseases (Figure 3). This occurs due to the sustained friction and pressure on the same location. Many people use N95 mask in accordance with the guidelines of WHO and the Indian Council of Medical Research (ICMR), but excessive use of the N95 mask and surgical mask causes skin injuries on various parts of the head and face. Continuous mask usage often causes facial scratching, symptoms of acne, and dermatitis [14]. The use of over-tight eye goggles inflicts damage to the skin surroundings the eyes and also creates fogs within the covered area. The mask itself can produce bruises all over the face. Notably, the hair is the most overlooked component of the body in this context. Hair contamination is prevented using a surgical cap or PPE, but continuously wearing these items causes sweating on the head and itching, scalp pruritus, folliculitis, and scalp seborrheic dermatitis with hydrosis and hair sweating [15]. Continuous use of shoes causes infections in the finger joints, itching, and redness, with the skin beneath the foot sometimes becoming white. Not only this but COVID-19 patients are also vulnerable to dermatitis. Some reported skin manifestations of COVID-19 include an erythematous exanthema (dengue-like rash), livedo reticularis, cutaneous vasculitis, acute urticaria, chickenpox-like blisters, and COVID toes (digital infarcts resulting in black, crusted lesions on the tips of fingers and toes) [16] (Figure 4). Furthermore, common people who are using hand sanitizers also experience skin rashes, hand irritation, and other forms of dermatitis.

Therefore, it is highly essential to use some precautionary measures for the treatment of skin dermatitis during the pandemic COVID-19 situation. Many allopathic or synthetic medicines in the form of creams, emollients, lotions, and ointments are used to control dermatitis before and after using PPE by healthcare professionals, but all these medicines possess some side effects. Hence, it is highly advisable to use herbal-based products to control dermatitis and achieve complete

Figure 4. Various forms of dermatitis observed in COVID-19 patients.

recovery. Natural medicinal and aromatic plants play important roles in preparing herbal cosmetics that are safe, non-toxic, and cost-efficient, and dermatologists can recommend such products to patients. The present review paper highlights the importance of herbal plants available in India and their successful use in the prevention of dermatitis during the COVID-19 situation.

Traditional and alternative medicine offers a vast range of herbal plants that serve as the key to unlock the ample number of mysteries behind human pathologies. In the modern era, more than 85% of the world population are using plant-based medicines and maintain their faith in applying traditional plants to cure many chronic skin diseases. Many Indian herbals are used for the treatment of influenza and COVID-19 without exerting any side effects. Some important herbals like *Aloe vera* contain aloe emodin that is effectively used against the influenza A virus via galectin-3 up-regulation [17] and even has a potential role against COVID-19 given its antiviral activity [18]. *Achyranthes aspera* acts as an antiviral plant as it contains triterpene acids, which are useful for the treatment of herpes viruses [19]. The methanolic extract of *Acorus calamus* was found to possess potent anti-dengue activity in vitro and in silico [20]. Furthermore, the aqueous extracts of plants like *Glycyrrhiza glabra, Allium cepa, Allium sativum, Ocimum sanctum, Piper nigrum, Cinnamomum verum, Zingiber officinale,* and *Curcuma longa*, along with lemon juice and honey, boost one's immunity and have effects in the treatment of viral infections like the flu and common cold [21-24].

Medicinal plants for skin infections during COVID-19 treatment

Emerging and reemerging infectious diseases are major threats to the world population. Furthermore, viral infections can cause a number of complications including skin conditions. Medicinal plants play an important role and offer potential against many viral infections, with their active constituents such as flavones, alkaloids, and polyphenols possessing antiseptic properties. Some important medicinal plants that are well known to act against dermatitis are listed in Table 1. The essential oils of sunflowers, flaxseeds, castor, lavender, rosemary, thyme, sandalwood, olives, eucalyptus, cloves, and fennels are not only effective against various forms of dermatitis but also moisturize and smoothen the skin due to their high antioxidant activity and potent inhibition of lipid peroxidation. These oils mostly possess antimicrobial activity. In this article, a short description of some important plants is provided along with specific usages for the treatment of skin infections.

Achyranthes aspera: This perennial plant is commonly known as the devil's horsewhip and is distributed throughout the tropical world. The plant is distributed in India, Sri Lanka, tropical Asia, Africa, Australia, and America. In India, the leaves are used as traditional medicine with many health benefits. The main chemical components are triterpenoid saponins that contain oleanolic acid as an aglycone. Apart from that, the plant contains alkaloids, flavonoids, saponins, and steroids. The main steroids present are β-sitosterol, ecdysone, and ecdysterone. Due to the presence of these compounds, the plant possesses anti-allergic activity. The leaves and roots are mixed with water or milk and applied as a paste onto the skin, minimizing rashes and irritation [25].

Acorus calamus: This plant is well known in India and is often called the sweet flag. It is a perennial plant. The plant is distributed in India, central Asia, southern Russia and Siberia, and Europe. The leaves and rhizomes mainly contain oils constituted of alpha and beta asarone (leaves), acorenone, and isocalamendiol (rhizomes), as well as saponins, lectins, sesquiterpenoids, steroids, and lignans. The paste of the rhizomes is used for treating all types of skin disorders (including rashes) due to the containing asarone, some steroids, and sesquiterpenoids [26]. The plant is highly antimicrobial, antifungal, and antiviral.

Alpinia galangal: This perennial plant is commonly known as the greater galangal and belongs to the ginger family. The plant is cultivated in all Southeast Asian countries as well as India, Bangladesh, China, and Surinam. Its rhizomes offer potent antibacterial and antifungal activity due to the presence of galangin (flavonol). Apart from that, the rhizome also contains galangol, cineol, pinene, and eugenol. It is used to heal burns and to reduce skin inflammation [27]. Fresh galangal slices help to remove scars or calluses from the skin [28]. It is used as an antiseptic cleanser that smoothens the skin and reduces the formation of acne given its antibacterial activity [29].

Table 1. Recommended herbal medicinal plants for cosmetic applications against dermatitis caused by COVID-19 and/or the excessive use of personal protective equipment.

Common name	Biological source	Family	Function
Devil's horsewhip	*Achyranthes aspera*	Amaranthaceae	Mainly used for the treatment of scabies and skin eruptions [70]
Calamus	*Acorus calamus*	Acoraceae	Helpful against atopic dermatitis [26]
Galangal	*Alpinia galangal*	Zingiberaceae	Effective against dermatitis [71]
Onion	*Allium cepa*	Liliaceae	It improves scar softness and skin redness [72]
Garlic	*Allium sativum*	Liliaceae	Maintains skin pigmentation and reduces skin rash; effective against skin cancer [73]
Aloe	*Aloe vera*	Liliaceae	Useful against all kinds of skin lesions and helpful against atopic dermatitis [74]
Satavari	*Asparagus racemosus*	Liliaceae	Helpful against atopic dermatitis and skin wrinkles [75]
Neem	*Azadirachta indica*	Meliaceae	Broad-spectrum antiviral; useful against all kinds of dermatitis [76]
Marigold	*Calendula officinalis*	Asteraceae	Effective against bruises, cutaneous inflammation, and other dermatitis conditions [77]
Green Tea	*Camellia sinensis*	Theaceae	Rejuvenates old skin cells and is effective against skin inflammation [78]
Charas	*Cannabis sativus*	Cannabinaceae	Relieves pain in itchy skin diseases; effective against dermatitis, seborrheic dermatitis, and varicose eczema [37]
Papaya	*Carica papaya*	Caricaceae	Effective against all skin rashes [79]
Dadukapatta	*Cassia alata*	Caesalpiniaceae	Leaf paste is mixed with the seed oil of *Pongamia pinnata* then applied externally for skin diseases [39]
Amaltas	*Cassia fistula*	Caesalpiniaceae	Bark is used for fungal skin diseases [40]
Brahmi	*Centella asiatica*	Umbelliferae	Treatment of wounds; protection against skin aging and UV damage [41]
Turmeric	*Curcuma longa*	Zingiberaceae	Reduces skin inflammation and is used for treating skin rashes; provides a cooling effect on the skin [80]
Gugul	*Commifera mukul*	Burseraceae	The paste is used in wrinkly and aged skin; improves skin color and wounds [43]
Devil bean	*Crotalaria retusa*	Fabaceae	Used in skin rashes and other skin infections [44]
Cucumber	*Cucumis sativus*	Cucurbitaceae	Freshens the skin and exerts a cooling effect; reduces skin redness and inflammation [81]
Purple coneflower	*Echinacea purpurea*	Asteraceae	Effectively used for skin boils, wounds, ulcers, burns, herpes, and hemorrhoids [47]
Wallich spurge	*Euphorbia hirta*	Euphorbiaceae	Useful against many skin diseases and rashes [48]
Peepal	*Ficus religiosa*	Moraceae	The powdered bark paste is good for many skin diseases [49]
Liquorice	*Glycyrrhiza glabra*	Leguminosae	Useful against skin diseases and rashes [50]
Indian sarsaparilla	*Hemidesmus indicus*	Apocyanaceae	Useful against skin diseases, gout, syphilis, and non-healing wounds [52]
Hibiscus	*Hibiscus rosa-sinenis*	Malvaceae	Useful in skin boils, wounds, ulcers, burns, and herpes [53]
Jasmine	*Jasminum officinale*	Oleraceae	The oil helps moisten the skin, thereby reducing dryness [54]
Henna	*Lawsonia inermis*	Lythraceae	Useful against foot and hand dermatitis [55]
Tomato	*Lycopersicon esculentum*	Solanaceae	Provides protection against the acute and potentially long-term aspects of photo damage to the skin [57]
Noni	*Morinda citrifolia*	Rubiaceae	Useful against contact dermatitis and skin inflammation [58]
Jatamansi	*Nardostachys jatamansi*	Valerianaceae	Useful against all kinds of skin diseases [59]
Tulsi	*Ocimum sanctum*	Labiatae	Useful in skin rashes and other dermatitis conditions [60]
Black pepper	*Piper nigrum*	Piperaceae	Seeds are used in wound healing and skin diseases [62]
Guava	*Psidium guajava*	Myrtaceae	Useful against various skin complaints and wounds [63]
Rosemary	*Rosmarinus officinalis*	Labiatae	Effective in preventing cutaneous photo damage induced by UV radiation [64]
Indian sandalwood	*Santalum album*	Santalaceae	Useful against skin inflammation, skin rashes, scalp pruritus, and folliculitis [82]
Ashok	*Saraca indica*	Fabaceae	The bark extract is useful in treating various skin problems [66]
Black nightshade	*Solanum nigrum*	Solanaceae	Leaves are used as a poultice for skin diseases [67]
Ginger	*Zingiber officinale*	Zingiberaceae	Fine paste applied on skin rashes and wounds [68]

Allium cepa: This plant is commonly known as the bulb onion. It is a perennial plant that is distributed throughout the world. It contains polyphenols, anthocyanins, phytosterols, and saponins. Due to possessing antioxidant properties, it is helpful in the treatment of acne and also reduces skin inflammation. It reduces nasal congestion due to the antihistamine properties of quercetin, which is present in the onion [29].

Allium sativum: Commonly known as the garlic, which is well-known throughout the world. It is widely distributed in most countries and is largely cultivated in India. It contains sulfur-containing compounds like allicin, ajoene, diallylpolysulfides, vinyldithiins, and S-allylcysteine, together with enzymes, saponins, and flavonoids. The garlic has strong antifungal, antibacterial and antiviral activity. This plant is recently in high demand for the treatment of COVID-19 given its antiviral properties, which enhance natural killer cell activity to destroy the infected cells [30]. The extract protects DNA against free radicals and defends against UV-induced skin cell damage [31].

Aloe vera: A succulent plant that is distributed throughout the world but grows mainly in Africa, Asia, Europe, and America. In India, it is well distributed, mainly being found in the Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, and Tamil Nadu provinces. More than 75 chemical constituents are available in the aloe plant, among which are aloe emodin, aloetic acid, anthranol, steroids such as campestrol, beta-sitosterol, and various enzymes. It accelerates wound contraction and increases the breaking strength of resulting scar tissue by enhancing the collagen content; it is also useful in treating radiation dermatitis, seborrheic dermatitis, and acne in the skin [32].

Asparagus racemosus: This plant is distributed throughout India, where it is commonly known as the shatavari. The root contains asparagamine A (a polycyclic alkaloid), steroidal saponins, shatavaroside A, shatavaroside B, filiasparoside C, shatavarins, and isoflavone. It protects against bacterial and fungal infections in the skin due to presence of flavonoids such as quercetin and rutin [33].

Azadirachta indica: This tree is commonly known as the neem. It is native to the Indian subcontinent and typically grows in tropical and semi-tropical regions. It contains various important constituents such as nimbin, nimbidin, nimbolide, limonoids, quercetin, beta-sitosterol (polyphenolic flavonoids), azadirachtin, azadirachtin A, and beta-sitosterol, and plays a role in disease management through modulation of various genetic pathways. The plant has strong antioxidant and antimicrobial properties, including antiviral characteristics. Recently, this plant extract has been used in the treatment of COVID-19 as it contains polyphenols. It is beneficial in the treatment of dermatitis eczema, skin rashes, skin redness, itching, acne, and skin damage from ultraviolet B radiation [34].

Calendula officinalis: This perennial plant is commonly known as the pot marigold. The leaves contain lutein, zeaxanthin, and beta carotene, while the flowers contain flavonol glycosides, triterpene, saponins, and sesquiterpene. This plant is highly effective in treating skin rashes, dermatitis, skin irritation due to radiation, and skin inflammation [35].

Camellia sinensis: An evergreen shrub that is commonly known as green tea. The leaves are its important part and possess high antioxidant activity due to the presence of carotene, riboflavin, nicotinic acid, pantothenic acid, and ascorbic acid. Caffeine, flavonoids like quercitrin, and tannin are its other important active constituents. The leaf extract, due to the presence of polyphenols, improves skin damage, erythema, and lipid peroxidation following UV exposure [36].

Cannabis sativus: This annual plant is known as cannabis; it is distributed throughout Asia, Europe, China, and America. The flowers contain cannabinoids. Apart from that, the plant also contains cannabidiol, cannabichromene, cannabigerol, terpenes, and phenolic compounds. It is helpful in the treatment of contact dermatitis, pruritus, skin inflammation, and even skin infections given the presence of polyphenols and flavonoids [37].

Carica papaya: This species is known as the papaya plant, which is distributed throughout Asia, South and Central America, southern Mexico, and Europe. In India, the papaya plant is abundantly distributed. The plant contains carotenoids, vitamin C, and many other vitamins. The leaves contain alkaloids, carpaine, and pseudocarpine, while the fruits contain various macro- and micro-nutrients. The plant also contains a protease enzyme known as papain. It is highly effective against skin conditions including rashes, acne, dermatitis, and eczema due to the presence of vitamin C besides certain minerals and enzymes [38].

Cassia alata: A shrub that is found throughout India and contains tannins, alkaloids, flavonoids, terpenes, anthraquinone, saponins, phenolics, cannabinoid alkaloids, 1,8-cineole, caryophyllene, limonene, α-selinene, and β-caryophyllene. However, the main constituents are chrysoeriol, kaempferol, quercetin, 5,7,4′-trihydroflavanone, 17-hydrotetratriacontane, palmitic acid, and stearic acid. The whole plant is effective against scabies, shingles, urticaria, itching, pityriasis versicolor, and ringworm. The seed of this plant is used as an antiseptic due to the presence of cannabinoid alkaloid (4-butylamine 10-methyl-6-hydroxy cannabinoid dronabinol) and apigenin. Its fresh leaves are used in the treatment of skin rashes, mycosis, and dermatitis [39].

Cassia fistula: This plant is commonly known as the Indian laburnum and grown throughout the Asian counties. In India, it is abundantly available. The plant contains alkaloids, terpenoids, reducing sugars, saponins, tannins, carbonyl, phlobatannins, and steroids. Its leaf paste is externally applied to cure eczema and other skin diseases [40].

Centella asiatica: The plant is well known in India as the brahmi. It is a perennial plant distributed in Asia, tropical Africa, Australia, and South America. It contains saponins like asiaticosides, asiatic acid, madecassoside, and madasiatic acid. Apart from that, the plant contains flavonoids (derivates of chercetin and kempferol), an alkaloid (hydrochotine), a bitter component (vallerine), and various fatty acids (linoleic, linolenic, oleic, palmitic and stearic acid). It is useful for various skin diseases such as leprosy, lupus, varicose ulcers, eczema, psoriasis, skin irritations, and other allergic reactions [41].

Curcuma longa: Commonly known as turmeric, which can be found worldwide. In India, the plant grows in most provinces. It is a golden plant with multiple therapeutic applications. Recently, this plant has been used as a treatment for COVID-19 due to its antiviral actions. It contains polyphenolic compounds known as curcuminoids (mixtures of curcumin, demethoxycurcumin, and bisdemethoxycurcumin), among which the main component is curcumin. It is very effective against various skin conditions like acne, atopic dermatitis, facial photoaging, pruritus, psoriasis, and radiodermatitis [42].

Commifera mukul: This plant is well known for its oleo-gum resin that exudes out from the plant, which is known as *Guggulu*. The plant is mainly located in India, Bangladesh, and Pakistan. In India, it is observed in the Rajasthan, Gujarat, Assam, Madhya Pradesh, and Karnataka provinces. It contains diterpenoids (*α*-camphorene and cembrene-A), triterpenoids (myrrhanol A and B; commipherol), sesquiterpenoids (cadinene), steroids (*E*-guggulsterone and *Z*-guggulsterone), long-chain aliphatic tetrols, aliphatic esters, ferulates, lignans (sesamin and diayangambin), and carbohydrates. Due to containing steroidal compounds, the plant is useful against skin eczema, skin rashes, other forms of dermatitis as well as skin inflammation and acne [43].

Crotalaria retusa: Commonly known as the devil bean or rattle weed. The plant is widely distributed in tropical Asia, Africa, and Australia. In India, it is found in all provinces. The plant mainly contains saponins, tannins, alkaloids, phenols, and sterols. The whole plant infusion is used to treat various types of infections with skin rashes given the presence of phenolic compounds and sterols [44].

Cucumis sativus: This plant is commonly known as the cucumber, a widely-cultivated creeping vine plant. It is distributed in Asia, Africa, and North and South America. In India, the plant is distributed in the Assam, Maharashtra, Karnataka, Tamil Nadu and West Bengal provinces. The plant mainly contains glycosides, alkaloids, tannins, proteins and amino acids, phytosterols, terpenoids, saponins, and phenolic compounds. Given the presence of phytosterols and phenolic compounds, the plant is used as a treatment for irritated skin, cutaneous eruptions, various skin problems, acne, cooling the eyes, and periorbital redness [45].

Echinacea purpurea: A perennial medicinal herb known as the purple coneflower or hedgehog coneflower. The plant grows in parts of North and South America, Africa, and Asia. In India, the plant is cultivated in the hilly areas of Shimla and Himachal Pradesh. Its aerial parts contain polypropenoids like chicoric acid, alkamides, flavonoids (rutoside, quercetin-7-glucoside, and kaempferol–3–rutinoside), glycosides (echinacoside; echinacin), essential oils, caffeic acid derivatives, polysaccharides, and glycoproteins. This plant has recently come into the spotlight for its potential benefits in the treatment of COVID-19 as it seems

effective in the prevention and/or treatment of upper respiratory tract infections (viral, bacterial and fungal) and acquired immunodeficiency conditions [46]. The plant is used to alleviate inflammatory skin conditions, dermatitis, and improve skin hydration [47].

Euphorbia hirta: This pantropical weed is perhaps native to India. However, it is also found in Australia and Africa. It contains key secondary metabolites such as flavonoids, triterpenoids, alkanes, amino acids, and alkaloids. Some important constituents are afzelin, quercitrin, myricitrin, rutin, quercitin, euphorbin-A, B, C and D, kaempferol, gallic acid, β-amyrin, β-sitosterol, heptacosane, nonacosane, shikmic acid, tinyatoxin, choline, camphol, and quercitol derivatives like rhamnose and chtolphenolic acid. The decoction of the dry herb has antiseptic properties and is used in the treatment of fungal infections, skin rashes, and skin diseases [48].

Ficus religiosa: Commonly known as the peepal tree, native to India. This species is well distributed in many other countries of East Asia, namely Bangladesh, Nepal, Pakistan, Myanmar, south-western China, northern Thailand, and Vietnam. The leaves contain flavonoids, terpenoids, tannins, etc., whereas the bark contains tannins, saponins, and flavonoids. The decoction of its bark and tender leaves is rich in flavonoids and is used as a skin wash for treating scabies, ulcers, and other skin diseases [49].

Glycyrrhiza glabra: Known as liquorice and sweet in nature. It is distributed throughout the world, especially in Spain, Italy, Turkey, Iraq, Iran, Central Asia, and the north-west part of China. In India, the plant is cultivated in Punjab and sub Himalayan tracts. The components include saponins, flavonoids, isoflavonoids, stilbenoids, and coumarins. The main active constituents in saponins are glycyrrhizin, liquiritic acid, and glycyrretol. Some important flavonoids like liquirtin, liquiritigenin, and neoliquiritin are present in the plant. The plant extract shows antimicrobial effects that are attributed to its isoflavonoid component. It is useful in the management of atopic dermatitis, eczema, and pruritus [50]. Recently, this plant has been recommended for boosting immunity against COVID-19 [51].

Hemidesmus indicus: Commonly named as the Indian sarsaparilla. This species is distributed throughout the tropical and subtropical parts of India, especially in the upper Gangetic plains and it Bengal, Madhya Pradesh, and South India. The leaves contain tannins, flavonoids, hyperoside, rutin, and coumarin derivatives. The root contains lupeol, hexatriacontane, alpha and beta amyrin, and sitosterol. It also contains coumarino-lignoid-hemidesminine, hemidesmin I and hemidesmin II50, and six pentacyclic triterpenes among which are two oleanenes and three ursenes. The plant is very effective against hand and foot eczema, urticaria, acne rosacea, and acne. It is also useful against skin inflammation due to the presence of sterols [52].

Hibiscus rosa-sinenis: This plant is known as the hibiscus, which is distributed widely in the tropical and subtropical regions of the world. In India, it is distributed throughout the various provinces. The plant contains various phytoconstituents like tannins, anthraquinones, quinines, phenols, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, protein, free amino acids, carbohydrates, reducing sugars, mucilage, essential oils, and steroids. The plant is effectively utilized for skin elasticity and fights skin damage by eliminating free radicals; it has skin moisturizing properties and acts as a skin cleanser by removing dirt due to presence of natural alpha hydroxy acids. It also brightens the skin complexion by stimulating collagen production. Finally, the plant is useful in hair treatment as it removes dandruff from the scalp [53].

Jasminum officinale: As a climbing shrub, this plant is commonly known as the jasmine. The plant is native to India, Sri Lanka and the Andaman Islands. In India, it grows mainly in the Karnataka, Tamil Nadu, Kerala, and Andhra Pradesh provinces. The plant contains alkaloids, coumarins, flavonoids, tannins, terpenoids, glycosides, emodine, leucoanthocyanins, steroids, anthocyanins, and saponins. It helps in skin revitalization and reduces skin inflammation and acne formation [54].

Lawsonia inermis: This species is commonly known as the henna plant. It is distributed throughout India, while also being available in Iran, Pakistan, Indonesia, Central Africa and the Middle East in general. The leaf extract contains alkaloids, carbohydrates, resins, saponins, sterols, tannins, lawsone, apigenin, luteolin and

cosmosine; it also contains a number of essential oils (ethyl hexadecanoate, (E)-methyl cinnamate, isocaryophyllene, (E)-beta-ionone, and methyl linolenate). The leaves are used for hair care as well as for treating dermatitis, cellulitis, erysipelas, impetigo, and folliculitis [55]. Due to the presence of ascorbic acid, it has effective antimicrobial activity and is a potent immunomodulatory [56].

Lycopersicon esculentum: This perennial plant is known as the tomato and is cultivated all over India. The plant contains organic acids such as ascorbic, ferulic, caffeic and *p*-coumaric acid, as well as lycopene, phenolic compounds, minerals, and hydroxycinnamic acids. The plant is used for the treatment of many infectious skin diseases. It is a highly effective antimicrobial and antifungal agent. Fungal skin pathogens often cause a red, itchy rash on skin folds, which can be treated with the fresh juice of tomato leaves [57].

Morinda citrifolia: Commonly known as the noni or Indian mulberry. This tree or shrub is native to Southeastern Asia and is distributed across Africa, Australia, Barbados, Cambodia, Florida, Hawaii, India, Jamaica, Java, Malaysia, Philippines, Polynesia, Puerto Rico, Tahiti, Thailand, and Vietnam. The plant contains lignans, oligo and polysaccharides, flavonoids, iridoids, scopoletin, catachin, beta sitosterol, alkaloids, and damnacanthal. The fruit is useful in the treatment of dermatoses such as ringworm, dry skin, acne, pustules, and other skin rashes. It also helps in reducing skin inflammation, skin irritation by UV radiation, and wrinkle formation [58].

Nardostachys jatamansi: This plant is commonly known as the *Jatamansi* and is distributed in India, Nepal, Bhutan, Burma, and Southwest China. In India, the plant is found in the Punjab, Uttar Pradesh, Sikkim, and Arunachal Pradesh provinces. It contains many phytoconstituents such as alpha-patchoulenese, angelicin, beta-eudesemol, beta-patchoulenese, beta-sitosterol, calarene, calarenol, elemol, jatamansin, jatamansinol, jatamansone, n-hexacosane, n-hexacosanol, n-hexacosanyl arachidate, n-hexacosanyl isolverate, nardol, nardostechone, norsechelanone, oroselol, patchouli alcohol, seychelane, seychellene, valeranal, and valeranone. The hair-like rhizome extract and powder are effective in the treatment of various skin diseases and can improve the complexion and lustre of skin. This plant acts as an antifungal agent to treat breakout on the skin. Pruritus, crusts, scaling near the ear, and psoriasis are treated with the rhizome extract [59].

Ocimum sanctum: The plant is well-known worldwide as the *Tulsi* or *Basil*. This is a holy plant in India, where it is referred to as the "*Holy Basil*" and is found in almost every province. It possesses antibacterial, antiviral, and antifungal activity. It flushes out dangerous toxins and regenerates the skin, and is used for the treatment of acne, eczema, and psoriasis among other skin diseases [60]. Therefore, in the COVID-19 situation, the plant is in high demand with its immune-boosting activity [61].

Piper nigrum: A flowering woody perennial vine is known as the black pepper. The plant is originated from the hills of South Western India and grows well in the Assam, Kerala, Meghalaya, and Tamil Nadu provinces. The plant mainly contains piperine, alkamides, piptigrine, wisanine, dipiperamide D, and dipiperamide E. It has strong antimicrobial and antiviral activity. Recently, this plant has been highly recommended in India for COVID-19 treatment as it boosts the immunity in host cells given the presence of piperine. It is effective against skin allergy, vitiligo, scabies, contact dermatitis, and acne as it regulates T-helper 2 cell cytokine production [62].

Psidium guajava: Commonly known as the guava tree, native to Mexico, Central America, the Caribbean, and the northern parts of South America; it is also cultivated throughout India. The plant contains essential oils, polysaccharides, enzymes, triterpenoids, alkaloids, steroids, glycosides, tannins, flavonoids, and saponins. Its specific compounds include lyxopyranoside, arabopyranoside, guaijavarin, guavins A, C, and D, quercetin, and vitamin C. It relieves the itching and redness of the skin. Due to the presence of sterols and flavonoids, the leaf extract is used to treat some bacteria associated with surgical wounds, burns, boils, and skin and soft tissue infections [63].

Rosmarinus officinalis: Popularly known as the rosemary, originating from the Mediterranean region and being widely distributed throughout the world in places like Algeria, China, the Middle East, Morocco, Russia, Romania, Serbia, Tunisia, Turkey, and India, where it is cultivated in the *Kashmir Valley*. Various plant constituents such as caffeic acid, carnosic acid, chlorogenic acid, monomeric acid, oleanolic acid, rosmarinic acid, and ursolic

acid are present in the plant extract, whereas alpha-pinene, camphor, carnosol, eucalyptol, rosmadial, rosmanol, rosmaquinones A and B, secohinokio, and derivatives of eugenol and luteolin are present in the isolated oil. The plant extract acts as an antibiotic due to the presence of polyphenols; it is highly effective against recurring flares of erythema, edema, scaling, and itching of the skin due to its powerful antioxidant and antimicrobial activity, which are related to certain constituents like carnosic acid, carnosol and rosmarinic acid [64].

Santalum album: This plant is known as the sandalwood and possesses elevated commercial value. It is indigenous to the tropical belt of peninsular India, eastern Indonesia (Timor and Sumba), and northern Australia. In India, the plant grows in the Assam, Bihar, Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh provinces. The heartwood contains essential oils (sesquiterpene alcohols especially α-trans-bergamotol, cis-α-santalol, cis-β-santalol, epi-cis-β-santalol, trans-β-santalol and cis-lanceol), dark resin, and tannic acid as its chief constituents, in addition to hydrocarbons (α-santene and β-santene), alcohols (santenol, teresantalol), aldehydes (nortricycloecasantalol and isovaleraldehyde), ketones (santenone, santalone with santalic acids) and other components such as bisabolenals A to E and α-trans-bergamotenol. It is highly effective in healing dehydrated skin. The oil relieves pruritus and inflammation of the skin [65].

Saraca indica: Commonly known as the ashoka tree, the bark of this plant has major commercial value. The plant originates from the middle part of the Western Ghats province, western India. The tree is distributed throughout India, Sri Lanka, and China. In India, it grows in South India, Orissa, Assam, Maharashtra, and West Bengal. The bark contains procyanidin, epicatechin, 11'-deoxyprocyanidin B, catechin, leucopelargonidin, and leucocyanidin, whereas the flower mostly contains flavonoids such as quercetin, kaempferol, quercetin, apigenin- 7-0-p-D-glucoside, pelargonidin-3,5-diglucoside, and cyanidin-3,5-diglucoside. The seed and pod contain oleic, linoleic, palmitic, and stearic acid, as well as catechol, epicatechol, and leucocyanidin. Various skin complications such as eczema, psoriasis, acne, scabies, pruritus, skin inflammation, and dermatitis are cured by the bark extract, which even improves the complexion of the skin [66].

Solanum nigrum: This annual plant is commonly known as the black nightshade. It is found throughout the world especially in Europe, Asia, North America, South America, Australia, and Africa. Solanine, chaconine, and solasodine are the main three glyco-alkaloids present in the plant. The leaves contain steroidal glycosides, as well as high concentrations of gentisic acid, luteolin, apigenin, kaempferol and m-coumaric acid. The leaves and fruit extracts are directly applied to the skin for the treatment of psoriasis, hemorrhoids, deep skin infections, skin inflammation, skin burns, and acne due to presence of glyco-alkaloids [67].

Zingiber officinale: This rhizome-containing perennial plant is commonly known as ginger. Ginger is native to Southern Asia and is cultivated in many countries like India, China, Nepal, Indonesia, Nigeria, Bangladesh, Thailand, Philippines, Jamaica, Australia, Fiji, Brazil, Japan, the United Kingdom, the United States, Japan, and Saudi Arabia. The plant contains phenolic compounds like gingerols (6-gingerol, 8-gingerol, and 10-gingerol), shogaols, zingerone, gingerenone-A, 6-dehydrogingerdione, and paradols. It also contains ginger oil, which is made up predominantly by β-bisabolene, α-curcumene, zingiberene, α-farnesene, and β-sesquiphellandrene. Ginger has now become an essential immune booster for precautionary measures against COVID-19. The fresh juice improves immunity and reduces throat infection. The hot fresh ginger juice, after cooling, is used to reduce skin irritation, rashes, and inflammation as it contains gingerols. Ginger oil has antibacterial properties helps to soothe redness; it is useful in the treatment of eczema, psoriasis, dermatitis, and allergic rhinitis, and inhibits the signs of skin damage due to the presence of zingiberene, curcumene, beta sesquiphellandrene and alpha-pinene [68,69].

India is an agricultural land that represents one of the 17 mega biodiversity countries and contributes about 7% of global biodiversity with more than 8000 medicinal plant species. All these plant species have multiple therapeutic activities in the form of their extracts, formulations, or directly isolated compounds. There are three Indian traditional medicine systems, namely Ayurveda, Siddha and Unani; more than 90% of treatment

in these schools of medicine is through the use of plant-based formulations for many chronic diseases, including dermal infections. Currently, many people are still relying on herbal-based formulations for health-related issues. Therefore, it is advisable to the dermatologist and to the general public to be aware of the recommended herbal-based formulations for the management of dermal infections. Hence, some common natural plants are discussed in this review with potential benefits during the COVID-19 situation.

CONCLUSION

The COVID-19 pandemic has imposed an anxious state of life for most people. Health employees and other co-workers pass sleepless nights to resolve this pandemic. It is therefore important to provide protection to the healthcare workers along with the patients. The use of PPE and other protective measures is definitely useful, but excessive use and overprotection lead to severe skin problems such as eruptions, redness, acne, and other dermatological disorders. Although the dermatologist prescribes synthetic medicinal products to be used before and after the use of PPE or other precautionary items, there are some side effects. Therefore, herbal formulations are an alternative source for ameliorating these issues. As rich sources of active ingredients, herbals have great potential to cure different forms of skin diseases without leaving any side effects; the recommended plants are both non-toxic and accessible to the general public. In addition, not only Indians but also a large number of people worldwide rely on the use of various plant-based products to cure skin diseases ranging from rashes to skin cancer. Accordingly, the dermatologist can suggest the use of plant-based cosmetics in the form of ointments, creams, lotions, powders or aerosols before and after the use of PPE against COVID-19. Ultimately, this review listed some common herbal plants with their specific actions against skin infections so that researchers will be able to formulate novel commercial products for the treatment of skin diseases caused by overprotective measures taken during the COVID-19 pandemic.

Conflict of interest: None declared.

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