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Ethnodermatological use of medicinal plants in India: From ayurvedic formulations to clinical perspectives – A review

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ABSTRACT

Ethnopharmacological relevance: Traditional knowledge is a particular form of practice or skill set that was developed in ancient times and was sustained through generations via the passing of knowledge, essentially confined within a specific tribe, local people, or family lineages. Ethnodermatological use of medicinal plants in India is still a subject to conduct more studies to see if there is chemical, microbiological, and/or clinical evidence, from a scientific perspective, of their effectiveness for those skin disorders. Thus, this review can be the basis for further studies and may provide targets for drug development.

Aim of the study: We compile and emphasize the most important part of ethnodermatology, namely, traditional knowledge of medicinal plants and their applications for several skin diseases in India. We also include a brief review and explanation on dermatology in Ayurvedic and Unani medicine. We review the pharmacological activity of extracts derived from some of the most cited plants against problem skin diseases as well.

Materials and methods: Different kinds of key phrases such as "Indian traditional ethnodermatology", "ethnodermatology", "ethnobotany", "skin diseases", "Ayurveda dermatology", "pharmacological activity" were searched in online search servers/databases such as Google Scholar (https://scholar.google.com/), ResearchGate (https://www.researchgate.net/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), NISCAIR Online Periodicals Repository (NOPR) (http://nopr.niscair.res.in/). Based upon the analyses of data obtained from 178 articles, we formulated several important findings which are a summary shown in Tables. Tables. A total of 119 records of plants' uses have been found across India against 39 skin diseases. These are depicted with their localities of report, parts used, and preparation and administration methods against particular skin diseases.

Results: The knowledge and utilisation of herbal medicine in the Indian subcontinent has great potential to treat different kinds of human skin disorders. The administration of extracts from most of the plant species used is topical and few only are administrated orally. We also investigated the pharmacological activity of the extracts of the most cited plants against mice, bacterial and fungal pathogens, and human cells.

Conclusions: Complementary therapy for dermatological problems and treatment remains the main option for millions of people in the Indian subcontinent. This review on the practices of ethnobotanical dermatology in India confirms the belief that their analysis will accelerate the discovery of new, effective therapeutic agents for skin diseases. However, more studies and clinical evidence are still required to determine if the identified species may contribute to skin condition treatment, particularly in atopic eczema. Today, ethnodermatology is a well-accepted international discipline and many new practices have been initiated in numerous countries. We hope this article will further accelerate the development of this area to identify a new generation of natural human

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skin treatments that will help meet the growing consumer demand for safe, sustainable, and natural treatments. In this context, research on plants utilised in ethnodermatology in India and elsewhere should be intensified.

1. Introduction

The complementary or traditional medicinal system along with the presence of several cultural and socio-religious practices plays a major role in healthcare throughout the Indian subcontinent. Complementary and Alternative Medicine (CAM) in the field of dermatology covers a wide variety of diagnosis and treatment methods that complement conventional dermatology practices by drawing on an extended knowledge base that includes CAM together with the latest research findings (Tirant et al., 2018). CAM mainly focuses on treating the human body as a whole in the hope that this approach will benefit the dermatological treatment (Tirant et al., 2018). As reported by the World Health Organization (WHO), approximately 80% of the human population relies on traditional botanical medicines worldwide. Around 40,000 to 70,000 medicinal plant species are utilised across the world as traditional medicines (Verpoorte et al., 2006). Currently, the world trade in medicinal plants and derived products is evaluated at US$ 100 billion with an annual growth rate of 15% (Ahmad Khan and Ahmad, 2018).

Significantly, approximately 25% of contemporary pharmaceuticals are also derived directly or indirectly from plants, highlighting the solid basis for plant-derived medicines (Anand et al., 2019). Plants, due to their sessile nature have evolved the capacity to generate astounding chemical cornucopia (Anand et al., 2019). Furthermore, these plant-based natural products are chemically complex, typically consisting of multiple chiral centers. Thus, these molecules are difficult to chemically synthesise in the laboratory and often even where this is possible, the process is not commercially viable. It is the structural complexity of these plant-derived molecules that has directly contributed to their wide-ranging therapeutic activities (Anand et al., 2019, 2020; Banerjee et al., 2021; Das et al., 2021; Datta et al., 2021; Mohammed et al., 2021; Shoshan-Barmatz et al., 2021). Therefore, plants are routinely the only source of these medically significant biomolecules (Halder et al., 2021; Khare et al., 2021; Tandon et al., 2021).

India is one of the seventeen mega biodiversity centers in the world that also includes four biodiversity hotspots, namely, Western Ghats-Sri Lanka, Indo-Burma, Sundaland, and Himalaya (Fig. 1) (Venkataraman and Sivaperuman, 2018). It has been reported by the Botanical Survey of India (BSI) that out of the 45,000 plant species listed, at least 30,000 (two-thirds) are of high interest because of potential therapeutic potential (Nautiyal et al., 2015). Local people utilise some of these plants as herbal medicines, which are effective against a number of diseases. The application of traditional medicines for skin disorders is a well-established and commonly deployed practice in India (Yadav et al., 2012). Modern healthcare facilities are routinely not available in rural areas. Thus, traditional medicines are typically employed to address healthcare issues (Routh and Bhowmik, 1999). Overall, 84 species of medicinal plants are employed in dermatology throughout India. Specific plant species were found to be used in four Indian states with the majority being administrated in Tamil Nadu (24), Karnataka (17), Assam, and Uttar Pradesh (nine plant species in each) (Fig. 1). The ready availability of herbal plants, their lower cost, and minimal or absence of side effects has generated a growing demand for the application of these natural sources as treatments for various skin diseases (Abdelouahab and Heard, 2008). In India, even where contemporary medical systems are accessible, a large portion of the population still seeks the benefits of different types of alternative medications, for example, the Ayurvedic or Unani systems (Routh and Bhowmik, 1999; Dutta et al., 2021).

Ethnodermatology is a section of ethnomedicine and ethnobiology related to the diagnosis and treatment of various skin diseases/infections, skincare, and beautification in ethnic populations (Idu et al., 2011). The importance of the skin to the overall physiology of the human body is easily discernible due to the serious systemic disorders that appear after complex and severe damage to the skin by burns or generalized dermatitis (Idu et al., 2011). The skin barrier serves to limit passive water loss from the body, limits the absorption of chemicals from the environment, and prevents microbial infections (Vaughn et al., 2018). Key research has shown that natural plant-derived ingredients possess a rich potential source of cutaneous protection (Abdelouahab and Heard, 2008). In India, many herbal traditional medicines have been reported for treating several skin disorders: acne, bruises, and burns. Moreover, medicinal plants are most often used against cuts, wounds, skin diseases (generally), ringworm, eczema, leprosy, scabies, etc. (Fig. 2). Tribal and local people routinely use plant organs including leaves, fruit, seeds, and roots for the care and protection of human skin, its beautification, or treatment of associated diseases (Fig. 3) (Idu et al., 2011). Even *Cannabis indica* has demonstrated anti-inflammatory, antipruritic, anti-ageing, and anticancer properties by various mechanisms, including interacting with the newly found endocannabinoid system of the skin and thereby providing a promising alternative to traditional treatments (Sheriff et al., 2020). Moreover, cosmetic companies are increasingly applying basic research findings in the chemical and biological sciences to generate more sophisticated products in this area. In Europe only, the cosmetics industry has a €65 billion market size and employs a workforce of half a million indirectly or indirectly (Rinaldi, 2008). However, no comprehensive compilation of the ethno-dermatological reports have been attepted so far. In addition, besides some sparse evidence, the clinical relevance of such widespread traditional practices has not been described either.

The aim of the study is to compile and emphasize the most important part of ethnodermatology, namely, traditional knowledge of medicinal plants and their applications for several skin diseases in India. We also include a brief review and explanation on dermatology in Ayurvedic and Unani medicine. We review the pharmacological activity of extracts derived from some of the most cited plants against problem skin diseases as well.

2. Methodology

Different kinds of key phrases such as “Indian traditional ethnodermatology”, “ethnodermatology”, “ethnobotany”, “skin diseases”, “Ayurveda dermatology”, “pharmacological activity” were searched in online search servers/databases such as Google Scholar (https://scholar.google.com/), ResearchGate (https://www.researchgate.net/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), NISCAIR Online Periodicals Repository (NOPR) (http://nopr.niscair.res.in/) thus the appropriate databases and keywords were used. Only articles published in English language from 1975 to December 2020 were included for this study. A total number of 178 studies are included in the study from 213 published papers screened initially. Based upon the data obtained from different online search engines, we formulated several important findings. Table 1 presents plant species in traditional medicine against dermatological diseases in India, Table 2 presents the pharmacological activity of medicinal plants and their preclinical evidence, Table 3 presents clinical evidence of plant use in humans, Table 4 presents Ayurvedic formulations in dermatology, Table 5 presents herbal drugs and cosmetic products used in dermatology, and Table 6 presents bacterial pathogens responsible for the skin diseases in human body and related symptoms. Species names were checked against The Plant List 1.1 (“The Plant List,” 2013), and family names follow the Angiosperm Phylogeny Group IV (Chase et al., 2016).

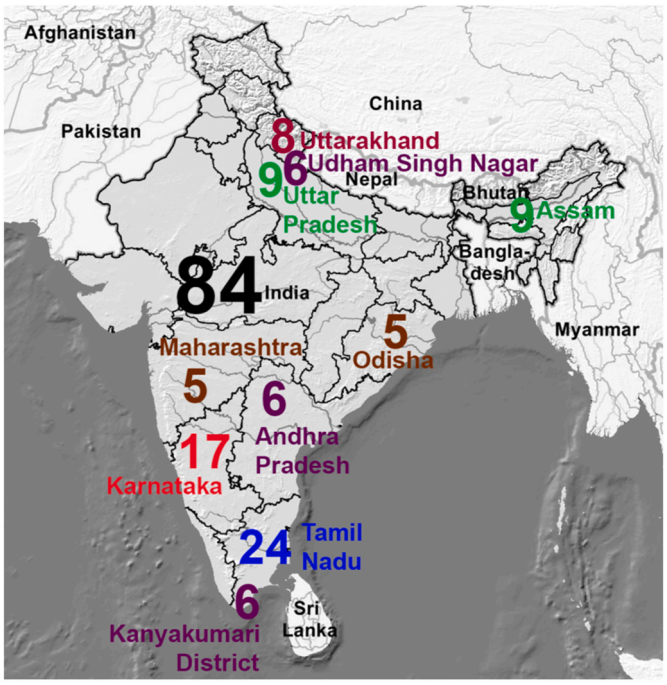

Fig. 1. Number of plant species reported from specific Indian states.

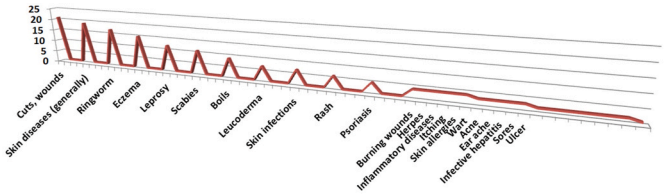

Fig. 2. Number of plant species reported deployed for dermatological problems in India. Y axis: number of plant species reported.

2.1. Dermatology in ayurvedic medicine

Ayurveda, translated as the science of life in Sanskrit, is deep rooted in South Asian history and culture. In India, detailed reports on different dermatologic treatments are outlined in Ayurveda texts. Causes of various dermatoses include dietary practice, daily activities, climatic conditions, or sexual activity. In the Ayurveda, "Rasayana drugs" are considered essential in the treatment of dermatological disorders (Tirant et al., 2018). The "Rasayana drugs" are immunomodulatory, adaptogenic, antioxidant, nootropic, and antistress (Tirant et al., 2018). According to Ayurveda, an analysis of prakruthi (nature) and local skin pathology (which is called Sthaneeya-vikruthi in Sanskrit) is mandatory before prescribing. Namely, prakruthi is considered important for long-term health control, and it has less utility for immediate short-term control. In this context, vikruthi is more important for short-term symptom management in skin diseases.

According to Ayurveda, there are three distinctive doshas or energies (vatha, pitta, and kapha), believed to circulate in the body to govern physical and mental activity. This means complex patterns of different symptoms and signs producing typical "constellations" of clinical signs and symptoms and only about 18 diseases are referred to in Ayurveda under the chapter kustha (meaning skin disease) (Narahari et al., 2013). Ayurvedic medicine has referred to the explanation of skin diseases with pathogenesis, etiology, clinical features, and effective treatment. Stubborn skin diseases, including leprosy, are triggered by inconsistency within several doshas. From consumption of contradictory liquids and food, fasting, excessive exercise, raw or undercooked food, drinking cold water after prolonged exposure to the sun, and early meal consumption before digesting the former, exceeding emetic therapy procedures, laxative treatment, medical enema, and inhalation therapy are responsible for these diseases. In Ayurvedic medicine for skin disease treatment, many preparations are used including medicinal plants (Fig. 4, Fig. 5): tinctures, ointments, emulsions, pastes, pills, suppositories, patches, lotions, liniments, oils, and bougie. Furthermore, chemical elements and inorganic compounds like copper, gold, lead, mercury, silver, sulfur, tin, zinc, zinc carbonate, alum, borax, and iron sulfate are also mentioned (Routh and Bhowmik, 1999). For acne, rubbing lemon is the best home remedy. The decoction of some plants such as *Justicia adhatoda* L. (= *Adhatoda vasica* Nees, Acanthaceae) (Vasak), *Acorus calamus* L. (Acoraceae) (Vaka), *Trichosanthes dioica* Roxb. (Cucurbitaceae) (Patola), *Azadirachta indica* A. Juss. (Meliaceae) (Neem), *Catunaregam spinosa* (Thunb.) Tirveng. (*Randia dumetorum* (Retz.) Poir., Rubiaceae) (Madana) with honey, while a paste made from some plants such as *Curcuma longa* L. (Zingiberaceae), *Senna alata* (L.) Roxb (Fabaceae), *Cynodon dactylon* (L.). Pers. (Poaceae), *Lawsonia inermis* L. (= *Lawsonia alba* Lam., Lythraceae), *Terminalia chebula* Retz. (Combretaceae) is used for treating several skin diseases such as pruritus, urticaria, eczema, cut wounds, acne, psoriasis, dermatitis, dermatophytosis, syphilis and scabies (Figs. 2 and 4) (Routh and Bhowmik, 1999) (Gilca et al., 2018). For example, it was found that an aqueous extract of *T. chebula* showed inhibitory effects higher than those measured in ethanol extracts (Fig. 5) (Vonshak et al., 2003). However, it should be also remembered that psoriasis, for example, is not a one disease from the Ayurvedic perspective as there are different vikruthis and prakruthis that can lead to the same end result of psoriasis. This case complicates the issue of controlling psoriasis.

2.2. Plants used in the treatment of skin disorders in India

In Bahraich of Uttar Pradesh, Tripathi and Srivastava (2010) found that a total of 11 medicinal plant species such as *Acalypha indica* L., *Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.), *Jatropha curcas* L., *Euphorbia thymifolia* Burm among others belonging to the Euphorbiaceae (Fig. 6, Fig. 7) family are used as home remedies for various skin diseases like eczema, leprosy, itching, wounds, ringworm, warts and scabies (Fig. 2) (Tirant et al., 2018). In Uttar Pradesh, 92 species of medicinal plants were cited, and the most common and most frequently used medicinal plants in the treatment of dermatological health problems were *Azadirachta indica* A. Juss, *Melia azedarach* L. (both from Meliaceae), and *Curcuma longa* L. (Zingiberaceae) (Kumar et al., 2013). In the Coastal Karnataka (Fig. 8), Bhandary and Chandrashekar (2011) reported 25 of 57 plant species, e.g., *Abrus precatorius* L. (Fabaceae), *Bridelia retusa* (L.) Spreng (Phyllanthaceae), *Rotheca serrata* (L.). Steane & Mabb (= *Clerodendrum serratum* (L.). Moon, Lamiaceae) that carry antiviral and other antimicrobial activities (Bhandary and Chandrashekar, 2011). Moreover, 16 plant species such as *Azadirachta indica* A. Juss., *Eclipta prostrata* (L.) L. (Asteraceae), *Celastrus paniculatus* Willd. (Celastraceae) have anti-inflammatory activity. The latter species showed also antifungal inhibitory activity (Vonshak et al., 2003). Ten species like *Acorus calamus* L., *Curcuma longa* L., *Centella asiatica* (L.) Urb. (Apiaceae) are attributed to wound/ulcer healing properties and six species such as *Cyclea peltata* Hook. f. & Thomson (Menispermaceae), *Centella asiatica* (L.) Urb., *Hemidesmus indicus* (L.) R. Br. ex Schult. (Apocynaceae) have cooling properties and *Citrus limon* (L.) Osbeck (Rutaceae) has the antiseptic property (Bhandary and Chandrashekar, 2011). In addition, this review reports the successful use of *Areca catechu* L. (Arecaceae), *Aristolochia indica* L. (Aristolochiaceae), *Coscinium fenestratum* Colebr (Menispermaceae), *Rauvolfia serpentina* (L.). Benth. ex Kurz (Apocynaceae), *Curcuma longa* L. for treating herpes (Bhandary and Chandrashekar, 2011). Saikia et al. (2006) documented 85 plant species belonging to 49 families for their therapeutic use in skin treatment in Assam (Fig. 8). Some of these medicinal plants are *Allium sativum* L. (Amaryllidaceae), *Justicia adhatoda* L., *Swertia chirata* Buch.-Ham. ex C.

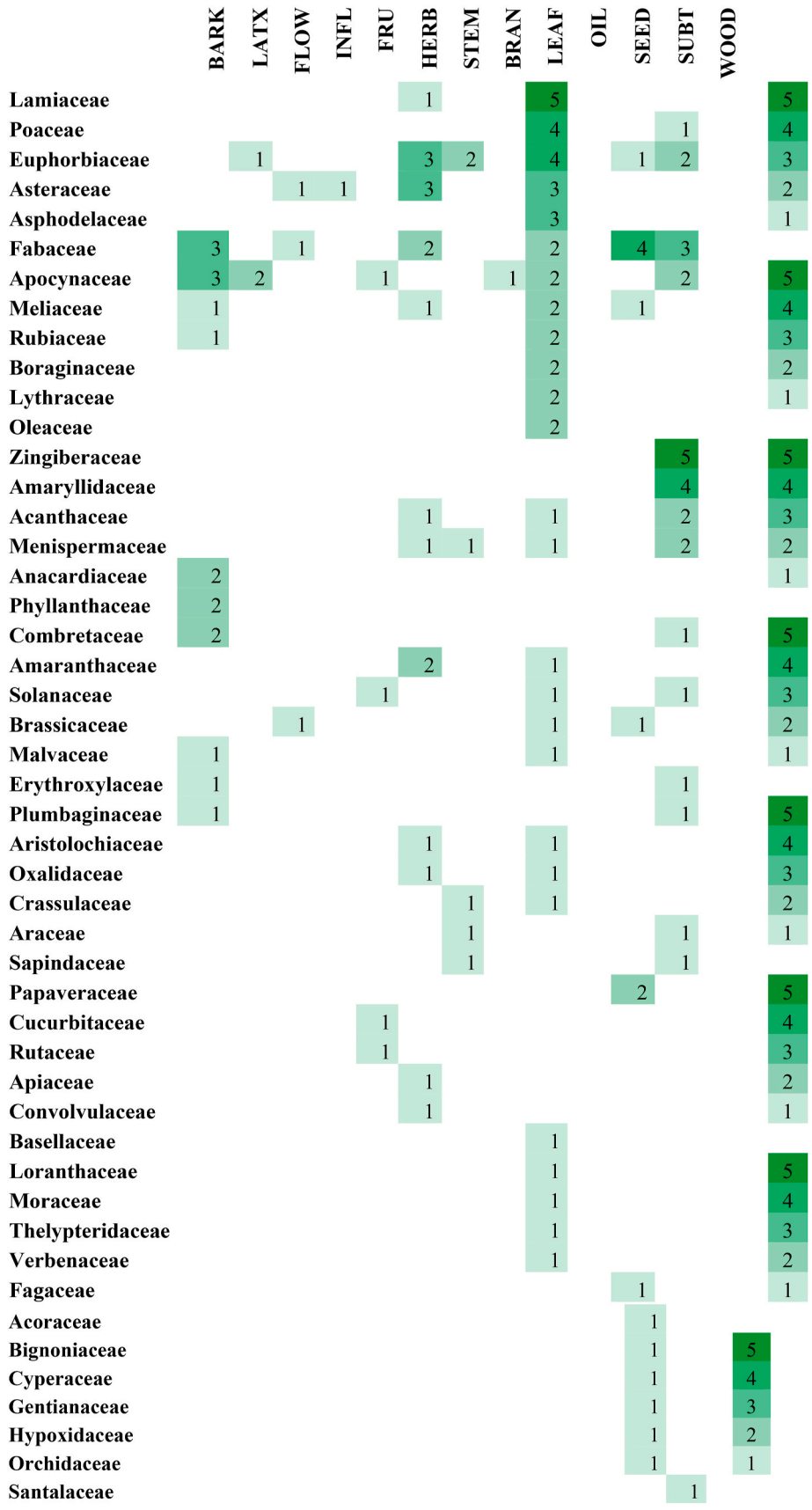

Fig. 3. Quantification of deployment in Indian ethnodermatology by plant parts and botanical family. BARK, LATX, FLOW, flowers; INFL, inflorescences; FRU, fruits; HERB, (= aerial parts); STEM, BRAN, branches; LEAF, OIL, SEED, SUBT, subterranean parts; WOOD.

Table 1
Traditional medicine against dermatological diseases in India.

Plant name	Family	Locality (state)	Plant parts	Preparation methods	Administration modes	Used against	Reference
Acalypha indica L.	Euphorbiaceae	Nanpara Tehsil, Bahraich, Uttar Pradesh	Leaves	Mixed with salt, paste	Topical	Eczema of hands, sole on legs, burning area, ringworm	Tripathi and Srivastava (2010)
Croton bonplandianus Baill.	Euphorbiaceae	Nanpara Tehsil, Bahraich, Uttar Pradesh	Latex		Topical	Scabies, sores	Tripathi and Srivastava (2010)
			Leaves	Paste	Topical	Cuts, wounds	
			Stem	Juice	Topical	Ringworm	
Jatropha curcas L.	Euphorbiaceae	Nanpara Tehsil, Bahraich, Uttar Pradesh	Seed	Oil	Topical	Leucoderma, sores, pimple	Tripathi and Srivastava (2010)
Ricinus communis L.	Euphorbiaceae	Nanpara Tehsil, Bahraich, Uttar Pradesh	Root	Decoction	Topical	Skin diseases, wart, wounds	Tripathi and Srivastava (2010)
			Fresh leaves	Paste	Topical	Wounds, carbuncle	
Citrus limon (L.) Osbeck	Rutaceae	Coastal Karnataka	Fruit	Paste	Oral	Anticeptic	Bhandary and Chandrashekar (2011)
Eclipta prostrata (L.) L.	Asteraceae	Coastal Karnataka	Whole plant	Decoction	Oral	Herpes, infective hepatitis	Bhandary and Chandrashekar (2011)
Coscinium fenestratum Colebr.	Menispermaceae	Coastal Karnataka	Stem	Decoction	Oral	Herpes, infective hepatitis	Bhandary and Chandrashekar (2011)
Croton persimilis Müll. Arg. (= *Croton roxburghii* N.P. Balakr., illeg. name)	Euphorbiaceae	Coastal Karnataka	Root	Decoction	Oral	Herpes, infective hepatitis	Bhandary and Chandrashekar (2011)
Bambusa vulgaris Schrad.	Poaceae	Perambalur, Tamil Nadu	Leaves	Decoction	Baby bath	Skin rashes	Balamurugan et al. (2019)
Calotropis procera (Aiton) Dryand.	Apocynaceae	Perambalur, Tamil Nadu	Latex	Decoction	Oral	Eczema, abdominal cramps, ringworms, snake bites and wound healing	Balamurugan et al. (2019)
Allium cepa L.	Amaryllidaceae	Perambalur, Tamil Nadu	Bulb	Cooking oil	Topical ear drop	Eczema, ear infection	Balamurugan et al. (2019)
		Ganjam District, Orissa	Bulb	Mixed with mustered oil	Topical	Inflammatory swelling	Mishra (2011)
Aloe vera (L.) Burm.f.	Asphodelaceae	Medline, Embase, Cochrane Library and CISCOM	Leaves	Juice	Topical	Severe and prolonged allergic dermatitis	Ernst (2000)
		India	Leaf, gel	Extraction	Topical	Acne, burning wounds, UV induced damage	Haniadka et al. (2013)
		Bidar district, Karnataka	Leaf	Juice	Topical	Scars, lesions, acne vulgaris	Prashantkumar and Vidyasagar (2008)
Santalum album L.	Santalaceae	East India	Heartwood	Oil	Topical	Acne, psoriasis, eczema, common warts, molluscum contagiosum	Moy and Levenson (2017)
Curcuma longa L.	Zingiberaceae	Jadavpur, Kolkata, West Bengal	Rhizome	Extraction	Oral	Premature skin wrinkle, excessive melanin secretion, hyperpigmentation	Biswas et al. (2016)
		India	Rhizome	Gel preparation extract	Topical	Psoriasis	Baliga et al. (2013)
Azadirachta indica A. Juss.	Meliaceae	India	Whole part	Paste	Topical	Scabies, chronic ulcer	Bedi and Shenefelt (2002)
		Tripura, India	Leaf, bark	Paste	Topical	Leprosy, skin infection, chicken pox	Sen et al. (2011)
		Jalgon District, Maharashtra	Seed	Paste	Topical	Rheumatism, skin diseases	(D. L. Jain et al., 2010)
Calotropis procera (Aiton) Dryand.	Apocynaceae	India	Root	Paste	Topical	Wart	Bedi and Shenefelt (2002)
Calendula officinalis L.	Asteraceae	Tamil Nadu, India	Flower heads	Extraction	Topical	Acne	Kumar et al. (2005)
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae	Haridwar, India	Stem bark	Decoction	Oral	Skin disease, skin itching	Bharati and Kumar (2014)
Brassica nigra (L.) K. Koch	Brassicaceae	India	Leaf, flower	Aqueous extract	Topical	Leprosy	(A. Gupta et al., 2010)
Desmodium oojeinense (Roxb.) H.Ohashi (= *Ougeinia oojeinensis* (Roxb.) Hochr.)	Fabaceae	India	Bark	Powder	Topical	Wound healing	(A. Gupta et al., 2010)
	Araceae	Kerala, India	Stem	Extraction	Topical		

(*continued on next page*)

Table 1 (*continued*)

Plant name	Family	Locality (state)	Plant parts	Preparation methods	Administration modes	Used against	Reference
Rhaphidophora pertusa (Roxb.) Schott						Skin diseases, ulcer, body inflammation	Shanavaskhan et al. (2012)
Calotropis gigantea (L.) Dryand.	Apocynaceae	Uttara Kannada district, Karnataka, India	Leaf, latex	Juice	Topical	Scabies, skin infection	Bhandary et al. (1995)
Dendrophthoe falcata (L.f.) Ettingsh.	Loranthaceae	Uttara Kannada district, Karnataka, India	Leaf	Paste	Topical	Skin ulcers	Bhandary et al. (1995)
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae	Uttara Kannada district, Karnataka, India	Stem bark	Decoction	Topical	Skin diseases	Bhandary et al. (1995)
Curculigo orchioides Gaertn.	Hypoxidaceae	Sonbhadra district, Uttar Pradesh, India	Root	Paste	Topical	Itching, skin diseases	Singh et al. (2002)
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	Sonbhadra district, Uttar Pradesh, India	Bark	Lotion	Topical	Astringent, leprosy	Singh et al. (2002)
Pongamia pinnata (L.) Pierre	Fabaceae	Gujarat, India	Seed	Oil	Topical	Burning area	Bedi (1978)
Lepidagathis incurva Buch.-Ham. ex D. Don	Acanthaceae	Northeast India	Whole plant	Decoction	Orally	Measles	Begum and Nath (2000)
Rhinacanthus nasutus (L.) Kurz	Acanthaceae	Northeast India	Root	pound with 6–7 match tips, mix with vaselline	Topical	Ringworm	Begum and Nath (2000)
Centella asiatica (L.) Urb.	Apiaceae	Northeast India	Whole plant	Grind	Topical	Syphilis	Begum and Nath (2000)
Excoecaria oppositifolia var. *crenulata* (Wight) Chakrab. & M.Gangop. (= *Excoecaria crenulata* Wight)	Euphorbiaceae	Madurai District, Tamil Nadu, India	Stem	Paste	Topical	Affected area of skin	Ignacimuthu et al. (2006)
Allium sativum L.	Amaryllidaceae	Assam, India	Bulb	Pieces was crushed	Topical, oral	Leprosy, ringworm, scabies	Ignacimuthu et al. (2006)
Basella alba L. (= *Basella rubra* L.)	Basellaceae	Assam, India	Leaves	Extracted juice	Topical	Urticaria	Ignacimuthu et al. (2006)
Bischofia javanica Blume	Phyllanthaceae	Assam, India	Bark	Crush	Topical	Insect bite	Saikia et al. (2006)
Datura stramonium L.	Solanaceae	Assam, India	Leaves	Paste, juice	Topical	Eczema, pediculosis	Saikia et al. (2006)
		Jalgon District, Maharashtra	Fruit	Juice	Topical	Skin disorder, ulcer	(D. L. Jain et al., 2010)
Dodonaea viscosa (L.) Jacq.	Sapindaceae	Villupuram district, Tamil Nadu, India	Stem, root	Decoction	Topical	Skin infections, skin rashes, sore throat, dermatitis	Sankaranarayanan et al. (2010)
Rhinacanthus nasutus (L.) Kurz	Acanthaceae	Villupuram district, Tamil Nadu, India	Root	Powder	Topical	Ringworm, skin diseases, chronic wound	Sankaranarayanan et al. (2010)
Cissampelos pareira L.	Menispermaceae	Villupuram district, Tamil Nadu, India	Root	Paste	Topical	Pruritus, skin disorder	Sankaranarayanan et al. (2010)
Anacardium occidentale L.	Anacardiaceae	Kanyakumari District, Southern India	Bark	Powder	Oral	Leprosy	Kingston et al. (2009)
Crinum viviparum (Lam.) R.Ansari & V. J.Nair (= *Crinum defixum* Ker Gawl.)	Amaryllidaceae	Kanyakumari District, Southern India	Bulb	Paste	Oral	Tinea cruris	Kingston et al. (2009)
Wrightia tinctoria R. Br.	Apocynaceae	Kanyakumari District, Southern India	Leaves	Pounded leaves with coconut oil	Applied twice a day	Psoriasis	Kingston et al. (2009)
		Andhra Pradesh, India	Stem bark	Extract	Topical	Skin diseases	Kahleel Basha and Sudarshanam (2010)
Caesalpinia crista L.	Fabaceae	Kannada District, Karnataka, India	Seed	Paste	Oral	Scabies, skin allergies	Harsha et al. (2003)
Aristolochia indica L.	Aristolochiaceae	Kannada District, Karnataka, India	Leaf	Juice	Topical	Wart	Harsha et al. (2003)
Globba marantina L.	Zingiberaceae	Eastern Ghats, India	Root	Fresh rhizomes crushed, mixed with Pongamia seed oil and paste applied on white spots	Topical	Leukoderma	Jeevan Ram et al. (2004)
	Oxalidaceae	Tamil Nadu, India	Leaves	Paste	Topical		

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Table 1 (*continued*)

Plant name	Family	Locality (state)	Plant parts	Preparation methods	Administration modes	Used against	Reference
Biophytum sensitivum (L.) DC.						Scabies, skin rashes, eczema	Chendurpandy et al. (2010)
Cissampelos pareira L.	Menispermaceae	Tamil Nadu, India	Whole plant	Paste	Topical	Ringworm infection, insect bites	Chendurpandy et al. (2010)
Rauvolfia serpentina (L.) Benth. ex Kurz	Apocynaceae	Tamil Nadu, India	Root	Oil extract	Topical	Leprosy, scabies, ringworm infection	Chendurpandy et al. (2010)
Canthium coromandelicum (Burm. f.) Alston (= *Canthium parviflorum* Lam.)	Rubiaceae	Kanyakumari district, Tamil Nadu, India	Leaves	Paste	Externally applied twice a day	Ringworm, Scabies	Chendurpandy et al. (2010)
Scleria lithosperma (L.) Sw.	Cyperaceae	Tamil Nadu, India	Rhizome	Paste	Topical	Eczema, leucoderma, scabies	Chendurpandy et al. (2010)
Cuscuta reflexa Roxb.	Convolvulaceae	Bihar, India	Whole plant	Paste	Topical	Leucoderma, eczema	Upadhyay et al. (1998)
Acorus calamus L.	Acoraceae	Arunachal Pradesh	Rhizome	Paste	Topical	Scabies, cut, injuries	Saklani and Jain (1989)
Ageratum conyzoides (L.) L.	Asteraceae	Assam, Meghalaya, Nagaland, Manipur	Leaves	Paste	Topical	Bites, cuts, wounds	Saklani and Jain (1989)
		Purulia District, West Bengal	Whole plant	Infusion	Topical	Wormy skin sores	Dey et al. (2012)
Aphanamixis polystachya (Wall.) R. Parker	Meliaceae	Nagaland	Leaves	Paste	Topical	Skin disease	Rao and Jamir (1982)
Ocimum tenuiflorum L. (= *Ocimum sanctum* L.)	Lamiaceae	Bidar District, Karnataka	Leaf	Paste	Topical	Ringworm	Prashantkumar and Vidyasagar (2008)
Tamarindus indica L.	Fabaceae	Bidar District, Karnataka	Leaf	Paste	Topical	Swelling on hands and legs	Prashantkumar and Vidyasagar (2008)
Nyctanthes arbor-tristis L.	Oleaceae	Purulia District, West Bengal	Leaf	Fresh/raw	Oral	Smoothen rough skin	Dey et al. (2012)
Exacum tetragonum Roxb.	Gentianaceae	Purulia District, West Bengal	Root	Paste	Topical	Sores of leech bites	Dey et al. (2012)
Abrus precatorius L.	Fabaceae	Assam	Root	Paste	Topical	Leucoderma	Buragohain and Konwar (2007)
		Chandauli District, Uttar Pradesh, India	Root	Paste with water	Topical	Dandruff	Poonam and Singh (2009)
Justicia adhatoda L. (= *Adhatoda zeylanica* Medik.)	Acanthaceae	Assam	Leaf	Paste	Topical	Abscesses	Buragohain and Konwar (2007)
Curcuma aromatica Salisb.	Zingiberaceae	Assam	Rhizome	Paste	Topical	Scabies, ringworm	Buragohain and Konwar (2007)
Bombax ceiba L.	Malvaceae	Mysore and Coorg District, Karnataka	Bark	Paste	Topical	Cattle wounds	Kshirsagar and Singh (2001)
Mallotus philippensis (Lam.) Müll. Arg.	Euphorbiaceae	Chandauli District, Uttar Pradesh, India	Leaves	Paste	Topical	Skin diseases	Singh and Singh (2009)
Argemone mexicana L.	Papaveraceae	Terai Arc Landscape, India	Seed	Oil	Topical	Skin infection, leprosy	Poonam and Singh (2009)
		Niyamgiri hills, Odisha, India	Seed	Paste	Topical	Eczema	Kumar et al. (2012)
Tabernaemontana undulata Vahl	Apocynaceae	Rajasthan, India	Bark, branch	Extraction	Chewed	Syphilis	Sharma and Kumar (2011)
Arisaema jacquemontii Blume	Araceae	West Himalaya, India	Bulb	Paste	Topical	Ringworm, skin disease	Pant and Samant (2010)
Woodfordia fruticosa (L.) Kurz	Lythraceae	Betul District, Madhya Pradesh, India	Leaf	Paste	Topical	Skin diseases	Dahare and Jain (2010)
Christella dentata (Forssk.) Brownsey & Jermy	Thelypteridaceae	Niyamgiri hills, Odisha, India	Leaf	Paste with coconut oil	Topical	Skin infection	Kumar et al. (2012)
Euphorbia hirta L.	Euphorbiaceae	Niyamgiri hills, Odisha, India	Whole plant	Paste	Topical	Cuts	Kumar et al. (2012)
		India	Whole plant	Paste	Topical	Eczema, ringworm, skin diseases	Jain (2003)
Pongamia pinnata (L.) Pierre	Fabaceae	Niyamgiri hills, Odisha, India	Seed	Oil	Topical	Eczema, skin infection	Kumar et al. (2012)
Erythroxylum monogynum var. *caffrum* Eyles	Erythroxylaceae	Nellore District, Andhra Pradesh, India	Root, stem bark	Juice	Topical	Affected skin	Savithramma et al. (2012)
Anisochilus carnosus (L. f.) Wall.	Lamiaceae	Odisha	Leaf	Crush	Topical	Itching	Saxena and Dutta (1975)
Cassia fistula L.	Fabaceae			Extract	Topical		

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Table 1 (*continued*)

Plant name	Family	Locality (state)	Plant parts	Preparation methods	Administration modes	Used against	Reference
		Jalgon District, Maharashtra	Leaves, flower, bark			Ringworm, skin infection, astringent	(D. L. Jain et al., 2010)
Sonchus arvensis L.	Asteraceae	Jalgon District, Maharashtra	Whole plant	Paste	Topical	Leprosy, white spot of skin, ringworm	(D. L. Jain et al., 2010)
Streblus asper Lour.	Moraceae	Erode District, Tamil Nadu	Leaf	Paste	Topical	Measles like swellings on the skin	Revathi and Parimelazhagan (2010)
Lantana camara L.	Verbenaceae	Erode District, Tamil Nadu	Leaf	Paste	Topical	Wounds	Revathi and Parimelazhagan (2010)
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	Erode District, Tamil Nadu	Bark, root	Extract	Topical	Unnecessary peelings on the skin	Revathi and Parimelazhagan (2010)
Indigofera aspalathoides DC.	Fabaceae	Erode District, Tamil Nadu	Whole plant	Ash of the whole plant was added with coconut oil	Topical	Psoriasis	Revathi and Parimelazhagan (2010)
Bauhinia variegata L.	Fabaceae	India	Bark	Extract	Topical	Leprosy, skin diseases	Jain (2003)
Momordica charantia L.	Cucurbitaceae	India	Fruit	Juice	Topical	Eczema	Jain (2003)
Tectona grandis L. f.	Lamiaceae	Palamalai hills, Coimbatore, Tamil Nadu	Leaf	Paste	Oral	Ulcer, skin diseases	Umapriya et al. (2011)
Aristolochia bracteolata Lam.	Aristolochiaceae	Palamalai hills, Coimbatore, Tamil Nadu	Whole plant	Decoction	Topical	Boils, skin disease	Umapriya et al. (2011)
Bryophyllum pinnatum (Lam.) Oken (= *Kalanchoe pinnata* (Lam.) Pers.)	Crassulaceae	Arunachal Pradesh, India	Leaf, stem	Crush	Topical	Skin burn	Namsa et al. (2009)
Bidens pilosa L.	Asteraceae	Arunachal Pradesh, India	Leaf	Paste	Topical	Cut, wound	Namsa et al. (2009)
Alpinia galanga (L.) Willd.	Zingiberaceae	Arunachal Pradesh, India	Rhizome	Rhizome powder mixed with young leaf paste of *Euphorbia neriifolia* L.	Topical	Local inflammation, skin allergy caused by insect bites or microbes	Namsa et al. (2009)
Oxalis corniculata L. (= *Oxalis corniculata* subsp. *albicans* (Kunth) Lourteig)	Oxalidaceae	Chittoor District, Andhra Pradesh, India	Whole plant	Juice	Gently rubbed on the skin for 2–5 days and also it can be taken orally for a month	Skin allergies	Jyothi et al. (2010)
Plumbago zeylanica L.	Plumbaginaceae	Chittoor District, Andhra Pradesh, India	Root, bark	Diluted paste	Applied on the skin for a period of 3–4 weeks	Leucoderma, ringworm	Jyothi et al. (2010)
Tinospora sinensis (Lour.) Merr. (= *Tinospora cordifolia* (Willd.) Miers)	Menispermaceae	Chittoor District, Andhra Pradesh, India	Root	Paste	Topical	Leprosy	Jyothi et al. (2010)
Cullen corylifolium (L.) Medik. (= *Psoralea corylifolia* L.)	Fabaceae	Chittoor District, Andhra Pradesh, India	Seed	Powder	Topical	Leucoderma, psoriasis, leprosy, inflammatory diseases of skin	Jyothi et al. (2010)
Raphanus raphanistrum subsp. *sativus* (L.) Domin (= *Raphanus sativus* L.)	Brassicaceae	Valsad district, Gujarat	Seed	Paste with little ghee	Topical	Fungal infection	Shah et al. (2011)
Solanum viarum Dunal	Solanaceae	Morigaon district, Assam, India	Root	Paste	Topical	Leprosy	Deka and Deka (2007)
Randia dumetorum (Retz.) Poir.	Rubiaceae	Central Western Ghats, Karnataka, India	Leaf	Paste	Topical	Skin ailments	Bhat et al. (2014)
Cynodon dactylon (L.) Pers.	Poaceae	South Travancore, Kanyakumari district, Tamil Nadu, India	Leaf	Mixed with coconut oil; paste	Topical	Skin ailments	Jeeva et al. (2007)
Lawsonia inermis L. (= *Lawsonia alba* Lam.)	Lythraceae	Hyderabad, Karnataka, India	Leaf	Paste	Topical	Heal cuts and wounds	Policepatel and Manikrao (2013)
Bridelia retusa (L.) Spreng.	Phyllanthaceae	Coastal region, Karnataka, India	Stem bark	Paste	Topical	Herpes	Bhandary and Chandrashekar (2011)
Euphorbia thymifolia Burm.	Euphorbiaceae	low hill region, Uttarakhand, India	Whole plant	Paste	Topical	Heal itching	Sharma et al. (2014)
Tridax procumbens (L.) L.	Asteraceae	Sub-Himalayan tract, India	Leaves	Paste	Topical	Cuts, wound	Sharma et al. (2014)
	Malvaceae		Leaves	Paste	Topical	Boils	Sharma et al. (2014)

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Table 1 (*continued*)

Plant name	Family	Locality (state)	Plant parts	Preparation methods	Administration modes	Used against	Reference
Sida cordata (Burm. f.) Borss. Waalk.		Udham Singh Nagar, Uttarakhand, India					
Millettia extensa (Benth.) Baker	Fabaceae	Udham Singh Nagar, Uttarakhand, India	Root	Paste	Topical	Boils, sores	Sharma et al. (2014)
Caesulia axillaris Roxb.	Asteraceae	Udham Singh Nagar, Uttarakhand, India	Flower	Paste	Topical	Cuts, wound	Sharma et al. (2014)
Vanda tessellata (Roxb.) Hook. ex G. Don	Orchidaceae	Udham Singh Nagar, Uttarakhand, India	Root	Paste	Topical	Boils, carbuncle	Sharma et al. (2014)
Ehretia laevis Roxb.	Boraginaceae	Udham Singh Nagar, Uttarakhand, India	Leaves	Paste	Topical	Wound	Sharma et al. (2014)
Eulaliopsis binata (Retz.) C.E. Hubb.	Poaceae	Udham Singh Nagar, Uttarakhand, India	Leaves	Juice	Topical	Wound	Sharma et al. (2014)
Rotheca serrata (L.) Steane & Mabb. (= *Clerodendrum serratum* (L.) Moon)	Lamiaceae	Dudhwa National Park, Lakhimpur Kheri District, Uttar Pradesh, India	Leaves	Mixed with mustard oil, paste	Topical	Eye-lid inflammation	Kumar and Bharati (2014)
Cyclea peltata Hook. f. & Thomson	Menispermaceae	Uttara Kannada district, Karnataka, India	Leaves	Paste	Topical	Boils	Bhat et al. (2014)
Vitex trifolia L.	Lamiaceae	Thodu hills, Kerala, India	Plant	Juice/decoction	Oral and topical	Wound	Xavier et al. (2014)
Jasminum grandiflorum L.	Oleaceae	Central Western Ghats, Karnataka, India	Leaves	Paste	Topical	Boils, eczema	Bhat et al. (2014)
Quercus infectoria G. Olivier	Fagaceae	South Travancore, Kanyakumari district, Tamil Nadu, India	Seed	Mixed with seeds of *Terminalia chebula* (Gaertn) Roxb.	Topical	Rash	Jeeva et al. (2007)
Verbena officinalis L.	Verbenaceae	Tarai region, Uttarakhand, India	Leaves	Crushed	Topical	Boils, cuts, wounds	Pandey et al. (2012)
Cymbopogon citratus (DC.) Stapf	Poaceae	Wayanad district, Kerala, India	Root, leaf	Paste, oil	Topical	Sprain and toothache	Silja et al. (2008)
Millingtonia hortensis L. f.	Bignoniaceae	Mayabunder, Andaman, India	Root	Paste	Topical	Skin disease, fever and pain	Chander et al. (2015)
Mimosa pudica L.	Fabaceae	Central Western Ghats, Karnataka, India	Whole Plant	Paste	Topical	Dermatitis, ringworm infection, eczema	Bhat et al. (2014)
Amaranthus spinosus L.	Amaranthaceae	Hyderabad, Karnataka, India	Whole Plant	Juice	Topical	Skin allergy	Policepatel and Manikrao (2013)
Achyranthes aspera L.	Amaranthaceae	Central Western Ghats, Karnataka, India	Plant, leaf	Paste	Topical	Boil, eczema	Bhat et al. (2014)
Nerium oleander L. (= *Nerium indicum* Mill.)	Apocynaceae	Pachamalai Hills, Tamil Nadu, India	Stem bark	Juice, mixed with gingelly oil	Topical	Ear ache	Bhaskar and Samant (2012)
Nerium oleander L. (= *Nerium indicum* Mill.)	Apocynaceae	Kalavai, Vellore district, Tamil Nadu, India	Fruit	Paste	Topical	Ear pain, rash	Natarajan et al. (2013)
Heliotropium indicum L.	Boraginaceae	Kancheepuram district, Tamil Nadu, India	Leaf	Paste	Topical	Wounds and skin affections	Muthu et al. (2006)
Vitex negundo L.	Lamiaceae	Bhandara district, Maharashtra, India	Leaf	Mixed with a number of herbs; juice	Topical	Boils	(R. Gupta et al., 2010)

B. Clarke [unresolved name, Gentianaceae], *Vitex negundo* L. (Lamiaceae), etc. (Saikia et al., 2006). In Tamil Nadu, SE India, Chendurpandy et al. (2010) investigated 88 plants that cure 15 different types of skin diseases; a maximum of 46 plants are used to treat ringworm infection, followed by 41 species for scabies, 24 for eczema, nine for leprosy, seven for cuts and wounds, five plants each for dandruff and skin inflammation, three for alopecia, two plants each for healing the cracked foot, cysts, polyps, acne and prickle heat (Fig. 2) (Chendurpandy et al., 2010). These 88 plants belong to 52 families such as Ceasalpiniaceae, Asteraceae, Euphorbiaceae, Fabaceae, Apocynaceae, Aristolochiaceae, Cucurbitaceae, Malvaceae, Rubiaceae, Zingiberaceae (Figs. 6 and 7) and some common plants in this study are *Azadirachta indica* A. Juss., *Curcuma aromatica* Salisb (Zingiberaceae), *Aloe vera* (L.). Burm. f. (Asphodelaceae), *Canthium coromandelicum* (Burm. f.) Alston (= *Canthium parviflorum* Lam., Rubiaceae), *Heliotropium indicum* L. (Boraginaceae), etc. (Chendurpandy et al., 2010). Upadhyay et al. (1998) reported a total of 54 medicinal plants from 34 families for curing skin diseases such as eczema, itching, cuts, burns, leucoderma, etc. in Bihar, eastern India. In this study, most of the common families used are Fabaceae, Lamiaceae, Euphorbiaceae (Figs. 6 and 7), and some of the medicinal plants are *Cuscuta reflexa* Roxb. (Convolvulaceae), *Bombax ceiba* L. (Malvaceae), *Datura metel* L. (Solanaceae), *Indigofera tinctoria* L.,

Table 2
Pharmacological/preclinical evidence.

Plant species and family name	Pharmacological activity	Extract/fractions/plant parts	*In-vitro/in-vivo/ex-vivo* assays/models	Reference
Symplocos racemosa Roxb. (Symplocaceae)	Antimicrobial activity	Ethanolic extract of bark	Disc diffusion method against *Propionibacterium acnes* and *Staphylococcus epidermidis*	Kumar et al. (2007)
Ammannia baccifera L. (Lythraceae)	Antimicrobial activity	Ethanolic extract of root	Disc diffusion method against *Propionibacterium acnes* and *Staphylococcus epidermidis*	Kumar et al. (2007)
Coccinia grandis (L.) Voigt (= *Coccinia indica* Wight and Arn.) (Cucurbitaceae)	Anti-inflammatory activity	Fruit juice powder	Carrageenin and histamine induced paw oedema	Deokate and Khadabadi (2012)
Azadirachta indica A. Juss. (Meliaceae)	Anti-inflammatory activity	Chloroform extract of stem bark	Carrageenin induced paw oedema in rat and mouse ear	Biswas et al. (2002)
	Antiulcer activity	Leaf aqueous extract	Rat exposed in restraint	Biswas et al. (2002)
	Anti-inflammatory activity	Ethanolic extract	Wister albino rats	Sharma et al. (2010)
	Wound healing activity	Pure neem oil and neem ointment	Incised and gap wounds in bovine calves	Bhardwaj and Sharma (1997)
Nelumbo nucifera Gaertn. (Nelumbonaceae)	Anti-inflammatory activity	Methanol extract	Oedema in rat paw caused by Carrageenan and serotonin	Paudel and Panth (2015)
		Ethanol extract	Proliferation of PMBC induced by phytohemagglutinin	Paudel and Panth (2015)
Citrus limon (L.) Osbeck (Rutaceae)	Antimicrobial activity	Whole plant extract	Antimicrobial susceptibility assays	Otang and Afolayan (2016)
	Antioxidant activity	Whole plant extract	Assay of DPPH scavenging activity	Otang and Afolayan (2016)
		Whole plant extract	Reducing power assay	
Aloe vera (L.) Burm.f. (Asphodelaceae)	Antimicrobial/ antifungal activity	Methanol and aqueous Extract	10% DMSO	Yebpella et al. (2011)
Cissus quadrangularis L. (Vitaceae)	Antimicrobial activity	Mehanolic extract (90%) and dichloromethane extract of stem	*S. aureus, E. coli, P. aeruginosa*	Shah (2011)
Celosia argentea L. (Amaranthaceae)	Wound healing activity	Alcoholic extract	Rat burn wound	Priya et al. (2004)
Ixora coccinea L. (Rubiaceae)	Wound healing activity	Alcoholic extract of flowers	Dead space rat	Nayak et al. (1999)
Centella asiatica (L.) Urb. (Apiaceae)	Wound healing activity	Ethanolic extract	Incision, excision, and dead space	Suguna et al. (1996)
Curcuma aromatica Salisb. (Zingiberaceae)	Anti-inflammatory activity	Aqueous and alcoholic extracts	Mice	Sikha et al. (2015)
	Wound healing activity	Powdered rhizome	Rabbits	
	Repellent activity	Ethanolic extract	Mosquito repellent activity	
	Anti-melanogenic activity	Plant extract	UVA-induced cellular oxidant formation and depletion of CAT and GPx activities and GSH content	
Rubia cordifolia L. (= *Rubia cordifolia* var. *affinis* Kurz) (Rubiaceae)	Wound healing activity	Root extract	Swiss albino mice	Karodi et al. (2009)
Curcuma longa L. (Zingiberaceae)	Anti-inflammatory activity	Rhizome extract	TNF induced NF-κB activation	Krup et al. (2013)
	Anti-allergic activity	Rhizome extract	48/80-induced rat peritoneal mast cell (RPMC) degranulation, 48/80-induced systemic anaphylaxis	
	Anti-dermatophytic activity	Rhizome powder	Cow's urine	
Biophytum sensitivum (L.) DC. (= *Biophytum sensitivum* var. *assamicum* Edgew. & Hook. f.) (Oxalidaceae)	Anti-inflammatory activity	Methanolic extract of aerial parts and roots	Carrageenin-induced rat paw oedema model	Jiny Varghese et al. (2010)
Neolamarckia cadamba (Roxb.) Bosser (= *Anthocephalus cadamba* (Roxb.) Miq.) (Rubiaceae)	Wound healing activity	Air-dried and powdered drug	Inbred house wistar rats, excision wound model, incision wound model	Sanjay et al. (2007)
Lagenaria siceraria (Molina) Standl. (Cucurbitaceae)	Anti-microbial activity	Methanolic extracts of the leaves, seeds, and fruit-flesh	Agar-well diffusion method	Prajapati et al. (2010)
Crocus sativus L. (Iridaceae)	Antitumor activity	Ethanolic extracts	Swiss albino mice	Vijaya Bhargava (2011)
Ocimum tenuiflorum L. (= *Ocimum sanctum* L.) (Lamiaceae)	Anti-inflammatory activity	Methanolic extract	Acute (carrageenan-induced pedal oedema) and chronic (croton oil induced granuloma and exudate formation) inflammations in rats	Pandey and Madhuri (2010)
Euphorbia hirta L. (Euphorbiaceae)	Anti-inflammatory activity	n-hexane extract of aerial parts	Phorbol acetate-induced ear inflammation in mice	Kumar et al. (2010)
Fumaria indica (Haussk.) Pugsley (Papaveraceae)	Antifungal activity	Alkaloid	Spore germination of some plant pathogenic fungi (*Collectotrichum* sp., *C. gloeosporioides, C. falcatum, Curvularia maculans, Curvularia lunata, Erysiphe cichoracearum*)	Gupta et al. (2012)
	Anti-inflammatory activity	Plant extract	Acute and chronic cotton models of inflammation in experimental animals	
Eclipta prostrata (L.) L. (= *Eclipta alba* (L.) Hassk.) (Asteraceae)	Antimicrobial activity	Methanol extract	Agar well diffusion method, DMSO	Dalal et al. (2010)
Acorus calamus L. (Acoraceae)	Wound healing activity	Ethanolic extract of leaves	Rats of either sex	Sharma et al. (2014)
	Antioxidant activity		DPPH assay	

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Table 2 (*continued*)

Plant species and family name	Pharmacological activity	Extract/fractions/plant parts	*In-vitro/in-vivo/ex-vivo* assays/models	Reference
		Methanol extract of leaf and rhizome		
Ageratum conyzoides (L.) L. (Asteraceae)	Wound healing activity	Petroleum ether, chloroform, methanolic and aqueous extract	Wistar albino rats of either rsex (150–250 g)	Sharma et al. (2014)
	Antioxidant activity	Whole plant methanol extract and essential oil	DPPH assay, Lipid peroxidases activity, FRAP assay	
Brassica juncea (L.) Czern. (Brassicaceae)	Wound healing activity	Ethanolic and aqueous extract	Male wistar albino rats (180–200g)	Sharma et al. (2014)
Cassia fistula L. (Fabaceae)	Wound healing activity	Methanolic and aqueous extract of bark	Wistar albino rats (170–200 g) of either sex	Sharma et al. (2014)
	Anti-inflammatory activity	Extract of leaves	Carrageenan, histamine and dextran induced paw oedema assays in rats	Danish et al. (2011)
Acalypha indica L. (Euphorbiaceae)	Wound healing activity	Alcoholic extract of whole plant	Excision and incision rat models	Ayyanar and Ignacimuthu (2009)
Anacardium occidentale L. (Anacardiaceae)	Antiulcerogenic activity, acute toxicity	Ethanolic extract of leaves	Wounded rats	Ayyanar and Ignacimuthu (2009)
Chromolaena odorata (L.) R.M.King & H.Rob. (= *Eupatorium odoratum* L.) (Asteraceae)	Anti-inflammatory activity	Aqueous extract of whole plant	Carrageenan induced oedema, cotton pellet granuloma and formalin induced oedema methods in rats	Ayyanar and Ignacimuthu (2009)
	Wound healing activity	Aqueous extract of the leaves	Wounded rat models	
Pongamia pinnata (L.) Pierre (Fabaceae)	Anti-inflammatory activity, ulcerogenic effect	Ethanolic extract of leaves	Acute, subacute and chronic models of inflammation in rats	Ayyanar and Ignacimuthu (2009)
Vitex altissima L.f. (Lamiaceae)	Wound healing activity	Leaf extracts	Excision, incision and dead space wounded rat models	Ayyanar and Ignacimuthu (2009)
Cedrus deodara (Roxb. ex D. Don) G. Don (Pinaceae)	Anti-inflammatory activity	Volatile oil extract of wood	Carragenan induced rat paw oedema method	Chaudhary et al. (2011)
Argemone mexicana L. (Papaveraceae)	Wound healing activity	Petroleum ether and butanol fractions of ethanol extract	Excision wound albino rat model	Brahmachari et al. (2013)
Ficus carica L. (Moraceae)	Anti-inflammatory activity	Petroleum ether (pee), chloroform and ethanol extracts of leaves	Carrageenan-induced rat paw oedema	Badgujar et al. (2014)
Hydnocarpus anthelminthicus Pierre ex Laness. (Achariaceae)	Wound healing activity	Aqueous methanol extract	STZ-induced diabetic male ICR mice	Sahoo et al. (2014)
Cleome viscosa L. (Cleomaceae)	Anti-inflammatory activity	Methanol extract	Carageenin, histamine, and dextran induced rat paw oedema	Mali (2010)
Rauvolfia tetraphylla L. (Apocynaceae)	Anti-inflammatory activity	Different extracts of root bark	Carrageenan induced acute inflammation in rats	Iqbal et al. (2013)
Trichosanthes dioica Roxb. (Cucurbitaceae)	Wound healing activity	Methanolic fruit extract	Excision and incision wound model in rat	Shivhare et al. (2010)
Senna alata (L.) Roxb. (= *Cassia alata* L.) (Fabaceae)	Anti-fungal activity	Leaf extract mixed with soap	Superficial skin infections caused by *Tinea versicolor* and *Tinea corporis* in human	Oladele et al. (2010)
Senna alata (L.) Roxb. (Fabaceae)	Anti-bacterial	Crude leaf extract	Growth inhibition of infection causing bacteria	Mensah Donkor (2016)
Cynodon dactylon (L.) Pers. (Poaceae)	Wound healing activity	Aqueous plant extract	Acute and dermatological toxicity study in Wister rat model	Biswas et al. (2017)
Achyranthes aspera L. (Amaranthaceae)	Wound healing activity	Methanolic leaf extract	Excision and incision wound model in albino rat	Fikru et al. (2012)
Nerium oleander L. (Apocynaceae)	Wound healing activity	*aloe vera* based plant extract (nae-8®)	Thermal injury-induced alterations and DNA repair mechanism in rat model	Gul Akgun (2017)
Mimosa pudica L. (Fabaceae)	Anti-dermatophilosis activity	Polyphenol rich seed extract	Topical emulgel based skin parameter study in human subjects	Ijaz et al. (2019)
Cymbopogon citratus (DC.) Stapf (Poaceae)	Mosquito repellent activity	Essential oil	Relative protection study against *Anopheles arabiensis* mosquitoes	Solomon et al. (2012)
Couroupita guianensis Aubl. (Lecythidaceae)	Skin care activity	Hydroalcoholic leaf extracts	Stimulation of human skin fibroblast (HSF) proliferation and UV-absorption study *in-vitro*	Martnez et al. (2012)
Mucuna pruriens (L.) DC. (Fabaceae)	Skin care activity	Plant extract	Sympathetic skin vasoconstrictions and axon reflex study	Kosteletzky et al. (2009)
Hibiscus syriacus L. (Malvaceae)	Chronic UVB induced skin damage protection	Dietary enzyme-treated flowers	Skin hydration and collagen synthesis studied in normal human dermal fibroblasts (NHDFs) *in vitro* and hairless mice *in vivo*	Yang et al. (2019)
Vitex trifolia L. (Lamiaceae)	Wound healing activity	Ethanol leaf extracts	Excision, incision and dead space wound models. in rats	Manjunatha et al. (2007)
Vitex doniana Sweet (Lamiaceae)	Cutaneous wound healing activity	Ethanol plant extracts	Excision, incision and models in rats, planimetry and histological analysis.	Amegbor et al. (2012)
Hibiscus syriacus L. (Malvaceae)	Hair growth promoting activity	petroleum ether, benzene, chloroform, methanol, and water extracts of leaves	Hair growth initiation assay in albino mice	Punasiya et al. (2014)
Vitex altissima L. (Lamiaceae)	Wound healing activity	Methanolic leaf extract	Excision, incision and dead space wounded rat models	Manjunatha et al. (2007)
Couroupita guianensis Aubl. (Lecythidaceae)	Anti-bacterial activity	Alcoholic leaf extract	Resistance model against nosocomial infection induced bacteria	Roumy et al. (2015)

(*continued on next page*)

Table 2 (*continued*)

Plant species and family name	Pharmacological activity	Extract/fractions/plant parts	*In-vitro/in-vivo/ex-vivo* assays/models	Reference
Heliotropium indicum L. (Boraginaceae)	Wound healing activity	Petroleum ether, chloroform, methanol, and aqueous leaf extracts	Excision, incision and dead space wounded rat models	Dash and Murthy (2011)

etc. (Upadhyay et al., 1998). Ninety plant species from 86 genera and 48 families were used by the Tharu community (in district Udham Singh Nagar, Uttarakhand) in the treatment of different skin diseases, namely, body infection (2 species (spp.)), boils (32 spp.), burns (4 spp.), chilblains (2spp.), cracked heels (2 spp.), cuts (18 spp.), dandruff (3 spp.), eczema (10 spp.), hair fall (2 spp.), itching (7 spp.), leprosy (11 spp.), leucoderma (4 spp.), ringworm (5 spp.), toes infection (2 spp.), and wounds (38 spp.) (Fig. 2). According to the use value (UV), the plant species most preferred to cure cutaneous diseases was *Ricinus communis* L. (Euphorbiaceae) followed by *Azadirachta indica* A. Juss., *Ageratum conyzoides* (L.) L. (Asteraceae), *Allium cepa* L. (Amaryllidaceae), and *Tridax procumbens* (L.) L. (Asteraceae) (Sharma et al., 2014). The medicinal plants used for the treatment of skin-related disorders in the northeastern part of India, including the states of Arunachal Pradesh (Fig. 8), Manipur, Meghalaya, Mizoram, Nagaland (Fig. 8), and Tripura were reported by Begum and Nath (2000) (Begum and Nath, 2000). In this study, they documented 275 plant species belonging to 93 plant families, and the most common plants used were *Lepidagathis incurva* Buch.-Ham. ex D. Don (Acanthaceae), *Achyranthes aspera* L. (Amaranthaceae), *Nerium oleander* L. (= *Nerium indicum* Mill., Apocynaceae), *Centella asiatica* (L.) Urb., etc. (Begum and Nath, 2000).

Ethnopharmacological approaches and information on lesser-known Indian plants used in the treatment of cuts, wounds, and burns have been compiled (Kumar et al., 2007) (Singh and Lal, 2008). Here, 51 plant species were indicated with 31% of the plants used to heal wounds, 29% for cuts and 10% for burns, and 22% for cuts and wounds (Fig. 2). An additional 64 Indian plants were reported with wound healing activity.

2.3. Pharmacological activities in preclinical and clinical evidences and cellular studies

Depending on dermatology ethnomedicinal use, plants have been confirmed by several pharmacological, clinical, and preclinical studies. The following section provides a comprehensive overview of the many experiments undertaken to test the bioactivity of plant extracts, fractions, and compound derivatives in *in vitro*, *ex-vivo,* and *in vivo* tests for some specific skin disorders. Tables 2 and 3 show the pharmacological investigations. Biological activities of plant extracts are anti-inflammatory, antifungal, wound healing, antiulcer, and antioxidant (Fig. 2). Most of the plant extracts are prepared using ethanol or methanol. Skin health is maintained by directly acting on the various layers and cells of the skin involved in the ageing process of skin dysfunction, as well as in the pathogenesis of the disease (Tirant et al., 2018).

Leprosy: Hansen's disease (HD) or leprosy is an infectious chronic disease caused by slow-growing bacteria, *Mycobacterium leprae* or *M. lepromatosis.* The serious disease mainly affects the skin, the upper respiratory tract (mucous surfaces), peripheral nerves, and eyes. The symptoms are skin lesions, nerve damage, red or light-colored skin patches with weakness in hands and feet, numbness, and reduced sensation. It is transmitted via droplets from the nose and mouth, during close and frequent contact with untreated cases. Leprosy is cured by multidrug therapy (MDT). Deka and Deka (2007) reported many of the medicinal plants used to treat leprosy such as leaves or root paste of *Amaranthus spinosus* L. (Amaranthaceae), and *Withania somnifera* (L.) Dunal (Solanaceae), bark decoction of *Cassia fistula* L. (Fabaceae), whole plant decoction of *Centella asiatica* (L.) Urb., root paste of *Solanum viarum* Dunal (Solanaceae), or fruit paste of *Momordica charantia* L. (Cucurbitaceae) (Deka and Deka, 2007; Paul et al., 2021). Joseph et al. (2013) documented that *Mimosa pudica* L. (Fabaceae) also helps to treat leprosy (Joseph et al., 2013). The antimicrobial activity of *M. pudica* methanol extract was checked against *Aspergillus fumigatus*, *Citrobacter divergens,* and *Klebsiella pneumoniae* at different concentrations of 50, 100 and 200 μg/disc. The anti-inflammatory effect of *M. pudica* leaf ethanol extract at doses of 200 and 400 mg/kg was tested for significant inhibition of carrageenan paw oedema and found that the analgesic effect was more pronounced with the acetic acid writhing model than with the tail-flick model (Joseph et al., 2013).

Kumar et al. (2014) studied the extraction of the stem bark of *Millingtonia hortensis* L. f. (Bignoniaceae) used to treat Dapsone resistance in leprosy (Kumar et al., 2014). The antibacterial activity of the extract of *M. hortensis* was examined by Well diffusion method. In this method, *Escherichia coli* was used as the test organism, four wells of 10 mm in diameter were made in all agar plates, and approximately 0.3 ml of plant extract of varying concentrations was added into the well with a sterilized dropper pipette and the kanamycin disc was added at the center of the plates which were then incubated at 37 °C for 20 h, thus the diameter of the inhibition zone was recorded to determine the antimicrobial activity (Kumar et al., 2014). In this study also, GC-MS analysis was performed on the methanolic and ethanolic extracts of *M. hortensis.*

Singh et al. (2013) studied the anti-inflammatory effect of methanol extract (400 mg/kg) of the *Cassia* species (Fabaceae), which showed a maximum setback of oedema of 53.57%, 40.33%, 31.37% and 29.15% at the end of 3 h with serotonin-induced, carrageenin, dextran, and histamine rat paw oedema and the extract exhibited a 48.13% reduction in granuloma weight in the granuloma pouch in rats by using the chronic test. The antiulcer activity of the methanolic seed extract of *Cassia* species was explored using a pylorus ligation model (75% protection) and 70.31% protection in ulcers induced by indomethacin in Wister albino rats (Shivjeet et al., 2013). The antipyretic activity of the root extract of *Calotropis gigantea* (L.) Dryand. (Apocynaceae) concluded yeast-induced fever and TAB (Typhoid) vaccine-induced pyrexia in rats and rabbits (Singh et al., 2014).

Ringworm: Ringworm is a fungal infection of the skin or scalp, also known as dermatophytosis, dermatophyte infection, or tinea. Three various kinds of fungi can cause ringworm: *Epidermophyton* sp., *Microsporum* sp., and *Trichophyton* sp. These fungi live in the soil in the form of spores. The infection initially appears as red spots on the affected areas of the skin and later spreads to other body parts. It can affect the scalp, groin, chin, feet, nails, or other areas. Singh et al. (2015) reported *Lawsonia inermis* L. was used as a treatment of ringworm, it has anti-inflammatory properties concluded by the extracted compounds, i.e., methyl naphthalene carboxylate and 1,5-Diphenylpent-3-en-1-ynes (obtained from leaves and stems) used in an *in-vitro* bioassay by measuring elastase release and superoxide production in human neutrophils (IC50 range was 1.58–1.80 μg/ml) and the crude ethanol leaf extract along with butanol, chloroform, and water fractions exhibited against the anti-inflammatory model of rat (Singh et al., 2015). Furthermore, this study documented the wound healing effect of *L. inermis* ethanol leaf extract on male Wistar rats in excision and dead space models and excision, incision and dead space models in Sprague Dawley rats (Singh et al., 2015). Ndhlala et al. (2015) studied *Achyranthes aspera* L. for treating ringworm. The antifungal activity of the methanol extracts from *A. aspera* leaves against *Candida albicans* (ATCC10231), a diploid yeast fungus, was assessed by means of a micordilution test. Its anthelmintic activity was also assessed against

Table 3
Clinical evidence and confirmation in cellular research.

Plant species and family name	Extract/plant parts/ fractions	Mode of action in human	References
Calendula officinalis L. (Asteraceae)	Aqueous extract of flowers	Stimulates the phagocytosis of human granulocytes, interferes neutrophil radical oxygen species (ROS) and radical nitrogen species (RNS) generation, particularly nitric oxide, a reduced pro-inflammatory marker including TNF - α, IL - 1β, (IL - 6), interferon gamma (IFN - γ), c - reactive protein (CRP), and cyclooxygenase - 2 (COX - 2)	(Tirant et al., 2018) (Kodiyan and Amber, 2015)
	Aqueous extract of flowers, water fraction	Normal human dermal fibroblasts (HDF) cell proliferation and migration	Dinda et al. (2016)
	Isolated calendula oil from calendula flowers	SPF of sunscreen formulations [calculated as the ratio of the minimal erythema dose (MED) of sunscreen-protected skin to the MED of unprotected skin]	Mishra et al. (2012)
Centella asiatica (L.) Urb. (Apiaceae)	Ethanolic extract of whole plant	Human monolayer cell culture, activates the smad pathway, increases collagen synthesis in human dermal fibroblasts cell, affects extracellular matrix proteins deposition	(Tirant et al., 2018) (Gohil et al., 2010) (Seevaratnam et al., 2012)
Aloe vera (L.) Burm.f. (Asphodelaceae)	Ethanolic extract	Synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue, fibroblast's activity and proliferation resulting in significantly increased collagen synthesis, Glucomannan and gibberellin interact with growth factor receptors on the fibroblast	Tirant et al. (2018)
	Ethanolic extract	Human colon cancer cell lines, human AML leukemic cells	Joseph and Justin Raj (2010)
Phyllanthus emblica L. (Phyllanthaceae)	Aqueous extract of dried fruit	Chromium-induced oxidative damage through decreased GSH and GPx activity in macrophages, inhibition of matrix metalloproteinase levels, MMP-1, hyaluronidase activities, promotion of pro- collagen content UV-B induced skin photo ageing in fibroblasts by MTT assay, marked up-regulation of cytokine (il-10) concentration, efficient reduction of cytokine (tnf- α and il-1β) levels	(Tirant et al., 2018) (Dang et al., 2011)
Terminalia chebula Retz. (Combretaceae)	Extract of fruits	Enhances concentration of melatonin in the pineal gland and the levels of cytokines, increases concentration of antioxidant enzymes, GSH, T and B cell	Tirant et al. (2018)
Cullen corylifolium (L.) Medik. (= *Psoralea corylifolia* L.) (Fabaceae)	Aqueous extract	Human cell lines, human liver-derived HepG2 cells, keratinocytes replication in psoriasis, inhibition on IL-6-induced STAT3 activation and phosphorylation	(Tirant et al., 2018) (Khushboo et al., 2010)
Azadirachta indica A. Juss. (Meliaceae)	Aqueous extract of bark	Human serum	Biswas et al. (2002)
	Aqueous extract of leaves	IgM and IgG levels along with increased titer of anti-ovalbumin antibody	
	Extract of leaves	Certain human fungi, including *Trichophyton* sp., *Epidermophyton* sp., *Microsporum* sp., *Trichosporon* sp., *Geotricum* sp. and *Candida* sp.	
Curcuma longa L. (Zingiberaceae)	Extracts of rhizomes	H_2O_2-induced damage in human keratinocytes and fibroblasts and in NG 108–15 cells, human erythrocyte by oxidizing oxyhaemoglobin	Chattopadhyay et al. (2004)
Datura metel L. (Solanaceae)	Methanol extract of flowers	Human lung carcinoma cells, human colorectal adenocarcinoma cells	Al-Snafi (2017)
Calotropis gigantea (L.) Dryand. (Apocynaceae)	Extract of latex	Human fibrinogen, human blood sample, human blood clot and plasma clot	Rajesh et al. (2005)
Ocimum tenuiflorum L. (= *Ocimum sanctum* L.) (Lamiaceae)	Ethanolic extract	Human keratinocyte cell lines, human A549 lung cancer cells, human fibrosarcoma cells, cultured human lymphocytes	Baliga et al. (2013)
Hibiscus syriacus L. (Malvaceae)	Ethanolic cell culture extract	Stimulated fibronectin and collagen synthesis in human HaCaT keratinocytes and Human Dermal Fibroblasts (HDF)	Di Martino et al. (2017)

Caenorhabditis elegans var. Bristol (N2), a free-living nematode, using the rapid colorimetric microdilution test with modifications to obtain the minimum lethal concentration (MLC) values (Ndhlala et al., 2015). Ibrahim and Osman (1995) reported the leaves of *Senna alata* (L.) Roxb (= *Cassia alata* L.). have a laxative effect and are also used against ringworms. These plant extracts were utilised for antimicrobial activity test by the diffusion method, with 1 ml of 105 bacterial cells inoculum or 4 × 105 yeast cells or fungal spores per plate and discs with concentration 500 mg/ml were incubated at 30 °C for three days for fungi, or at 37 °C overnight for bacteria (Ibrahim and Osman, 1995). *In vitro* results showed that the extract had a high level of activity against dermatophytic fungi but a low level of activity against non-dermatophytic fungi.

Acne: Acne is the most common disease among all skin problems and has three major forms: *acne vulgaris, acne conglobata,* and *acne rosacea.* This is a skin condition that occurs when hair follicles become clogged with oil and dead skin cells. It often causes blackheads, whiteheads, or pimples, appearing on the face, forehead, chest, upper back, and arms. Manvitha and Bidya (2014) reported that *Cymbopogon citratus* (DC.) Stapf (Poaceae) (lemongrass) helps improve the skin by reducing acne and pimples and acts as a muscle and tissue toner (Karkala Manvitha, 2014). The ethanolic extracts of the leaves of lemongrass were explored to find potential antimicrobial properties against *Staphylococcus aureus* and both flavonoids and tannins are responsible for this activity as well (Karkala Manvitha, 2014). Kumar et al. (2007) documented the antibacterial screening of 12 Indian medicinal plants against acne-causing bacteria (Kumar et al., 2007). In this study, 12 medicinal ethanolic plant extracts such as 300 g *Verbena officinalis* L. (Verbenaceae, roots, 20.2% w/w), *Quercus infectoria* G. Olivier (Fagaceae, fruits, 19.1% w/w), *Berberis aristata* DC. (Berberidaceae, roots, 25.4% w/w), *Cocos nucifera* (Arecaceae, seeds, 19.9% w/w), *Couroupita guianensis* Aubl. (Lecythidaceae, roots, 16.9% w/w), *Jasminum grandiflorum* L. (Oleaceae, flowers, 17.3% w/w), *Mucuna pruriens* (L.) DC. (Fabaceae, seeds, 20.1% w/w), *Symplocos racemosa* Roxb. (Symplocaceae, barks, 19.5% w/w), *Tectona grandis* L. f. (Lamiaceae, roots, 17.7% w/w), *Hibiscus syriacus* L. (Malvaceae, roots, 18.4% w/w), *Ammannia baccifera* L. (Lythraceae, roots, 15.6% w/w), and *Vitex trifolia* L. (Lamiaceae, roots, 12.5% w/w) were tested for antimicrobial activity against *Propionibacterium acnes* and *Staphylococcus epidermidis* by disc diffusion method. This method showed that only seven medicinal plants (*Ammannia baccifera, Berberis aristata, Couroupita guianensis, Hibiscus syriacus, Mucuna pruriens, Quercus infectoria, Symplocos racemosa*) prevent the growth of *Propionibacterium acnes* (Kumar et al., 2007).

Eczema: A particular type of skin inflammatory reaction where there is erythema (reddening), oedema (swelling), and papules (bumps) on

Table 4
Ayurvedic formulations in dermatology.

Ayurvedic formulation	Ingredients	Used as/against	Reference
Navayasa Rasayana Leha	*Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae), *Terminalia chebula* Retz. (Combretaceae), *Embelia ribes* Burm.f. (Primulaceae), *Plumbago zeylanica* L. (Plumbaginaceae), *Semecarpus anacardium* L.f. [unresolved] (Anacardiaceae), *Cullen corylifolium* (L.) Medik. (= *Psoralea corylifolia* L.) (Fabaceae), Iron oxide, *Eclipta prostrata* (L.) L. (Asteraceae)	Anti-inflammatory, immunomodulatory activity,	Tirant et al. (2018)
Medhya Rasayana	*Acorus calamus* L. (Acoraceae), *Terminalia chebula* Retz. (Combretaceae), *Nardostachys jatamansi* (D. Don) DC. (Caprifoliaceae), *Celastrus paniculatus* Willd. (Celastraceae), *Glycyrrhiza glabra* L. (Fabaceae), *Semecarpus anacardium* L.f. [unresolved] (Anacardiaceae), *Tinospora sinensis* (Lour.) Merr. (= *Tinospora cordifolia* (Willd.) Miers) (Menispermaceae), *Bacopa monnieri* (L.) Wetts. (Plantaginaceae), *Convolvulus prostratus* Forssk. (= *Convolvulus pluricaulis* Choisy) (Convolvulaceae)	Antiproliferative, antioxidant	Tirant et al. (2018)
Divya Kayakalpa Taila	*Azadirachta indica* A. Juss. (Meliaceae), *Berberis aristata* DC. (Berberidaceae), *Senna tora* (L.) Roxb. (= *Cassia tora* L.) (Fabaceae), *Cedrus deodara* (Roxb. ex D. Don) G. Don (Pinaceae), *Curcuma longa* L. (Zingiberaceae), *Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Leucas cephalotes* (Roth) Spreng. (Lamiaceae), *Nigella sativa* L. (Ranunculaceae), *Picrorhiza kurrooa* Royle ex Benth. [unresolved] (Plantaginaceae), *Paullinia pinnata* L. (Sapindaceae), *Cullen corylifolium* (L.) Medik. (= *Psoralea corylifolia* L.) (Fabaceae), *Pterocarpus santalinus* L.f. (Fabaceae), *Rubia cordifolia* L. (Rubiaceae), *Sapindus trifoliatus* L. (Sapindaceae), *Smilax ornata* Lem. (Smilacaceae), *Sesamum indicum* L. (Pedaliaceae), *Solanum indicum* L. (Solanaceae), *Swertia chirata* Buch.-Ham. ex Wall. [unresolved name] (Gentianaceae), *Terminalia chebula* Retz. (Combretaceae), *Tinospora sinensis* (Lour.) Merr. (= *Tinospora cordifolia* (Willd.) Miers) (Menispermaceae)	Skin diseases like ring worm, itching, sun burning, eczema, leucoderma, psoriasis, urticaria, skin allergy	(B. Aggarwal et al., 2011)
Divya Kesa Taila	*Abrus precatorius* L. (Fabaceae), *Bacopa monnieri* (L.) Wetts. (Plantaginaceae), *Berberis aristata* DC. (Berberidaceae), *Callicarpa macrophylla* Vahl (Lamiaceae), *Cyperus rotundus* L. (Cyperaceae), *Eclipta prostrata* (L.) L. (Asteraceae), *Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Fagonia chilensis* Hook. & Arn. (= *Fagonia cretica* var. *aspera* (Gay) Engl.) (Zygophyllaceae), *Indigofera tinctoria* L. (Fabaceae), *Mesua ferrea* L. (Calophyllaceae), *Nardostachys jatamansi* (D. Don) DC. (Caprifoliaceae), *Nelumbo nucifera* Gaertn. (Nelumbonaceae), *Onosma echioides* L. (Boraginaceae), *Pandanus tectorius* Parkinson ex Du Roi (Pandanaceae), *Pterocarpus santalinus* L.f. (Fabaceae), *Sida cordifolia* L. (Malvaceae), *Symplocos paniculata* (Thunb.) Miq. (= *Symplocos crataegoides* Buch.-Ham. ex D. Don) (Symplocaceae)	Hair fall, dandruff, alopecia, premature graying of hair	(B. Aggarwal et al., 2011)
Divya Kanti Lep	*Areca catechu* L. (Arecaceae), *Cinnamomum camphora* (L.) J. Presl (Lauraceae), *Curcuma amada* Roxb. (Zingiberaceae), *Curcuma longa* L. (Zingiberaceae), *Myristica fragrans* Houtt. (Myristicaceae), *Rubia cordifolia* L. (Rubiaceae), *Santalum album* L. (Santalaceae), *Valeriana wallichii* DC. (Caprifoliaceae)	Pimples, acne, wrinkles on face	(B. Aggarwal et al., 2011)
Vipadikahara ghrita taila	*Leptadenia reticulata* (Retz.) Wight & Arn. (Apocynaceae), *Rubia cordifolia* L. (Rubiaceae), *Berberis aristata* DC. (Berberidaceae), *Mallotus philippensis* (Lam.) Müll. Arg. (Euphorbiaceae), *Shorea robusta* Gaertn. (Dipterocarpaceae), *Sesamum indicum* L. (Pedaliaceae), Cow's milk and ghee (clarified butter)	Skin lesions	Hewageegana et al. (2013)
Aragwadharistam	*Cassia fistula* L. (Fabaceae), *Embelia ribes* Burm.f. (Primulaceae), *Saccharum officinarum* L. (Poaceae), honey, *Phyllanthus emblica* L. (Phyllanthaceae), *Terminalia chebula* Retz. (Combretaceae), *Operculina turpethum* (L.) Silva Manso (Convolvulaceae), *Elettaria cardamomum* (L.) Maton (Zingiberaceae), *Syzygium aromaticum* (L.) Merr. & L.M. Perry (Myrtaceae), *Piper nigrum* L. (Piperaceae)	Skin disorders, ulcers	Mohammad et al. (2019)
Chyawanprash	*Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Justicia adhatoda* L. (= *Adhatoda vasica* Nees) (Acanthaceae), *Aegle marmelos* (L.) Corrêa (Rutaceae), *Asparagus racemosus* Willd. (Asparagaceae), *Boerhaavia diffusa* Brandegee [unresolved] (Nyctaginaceae), *Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm. (Lauraceae), *Cinnamomum verum* J.Presl (= *Cinnamomum zeylanicum* Blume) (Lauraceae), *Dendrobium plicatile* Lindl. (= *Desmotrichum fimbriatum* Blume) (Orchidaceae), *Desmodium gangeticum* (L.) DC. (Fabaceae), *Elettaria cardamomum* (L.) Maton (Zingiberaceae), *Gmelina arborea* Roxb. (Lamiaceae), *Hedychium spicatum* Sm. (Zingiberaceae), *Jacquemontia paniculata* (Burm.f.) Hallier f. (= *Ipomoea paniculata* Burm.f.) (Convolvulaceae), *Mesua ferrea* L. (Calophyllaceae), *Nymphaea nouchali* Burm.f. (= *Nymphaea cyanea* Roxb. ex G. Don) (Nymphaeaceae), *Vigna trilobata* (L.) Verdc. (= *Phaseolus trilobus* Aiton) (Fabaceae), *Phyllanthus niruri* L. (Phyllanthaceae), *Piper longum* L. (Piperaceae), *Premna serratifolia* L. (= *Premna integrifolia* L.) (Lamiaceae), *Oroxylum indicum* (L.) Kurz (Bignoniaceae), *Pterocarpus santalinus* L.f. (Fabaceae), *Rhus succedanea* L. (Anacardiaceae), *Solanum virginianum* L. (= *Solanum xanthocarpum* Schrad. & H. Wendl.) (Solanaceae), *Solanum dulcamara* L. (Solanaceae), *Solanum indicum* L. [unresolved] (Solanaceae), *Stereospermum chelonoides* (L.f.) DC. (= *Stereospermum suaveolens* (Roxb.) DC. (Bignoniaceae), *Teramnus labialis* (L.f.) Spreng. (Fabaceae), *Terminalia chebula* Retz. (Combretaceae), *Tinospora crispa* (L.) Hook. f. & Thomson (Menispermaceae),	Antioxidant, skin photoaging, UV irradiation	Takauji et al. (2016)

(*continued on next page*)

Table 4 (*continued*)

Ayurvedic formulation	Ingredients	Used as/against	Reference
	Uraria lagopodoides (L.) DC. (= *Uraria lagopoides* (L.) DC) (Fabaceae), *Vitis vinifera* L. (Vitaceae) and *Withania somnifera* (L.) Dunal (Solanaceae)		
Chopchiniyadi Churna	*Smilax china* L. (Smilacaceae) (roots), *Piper longum* L. (Piperaceae) (fruits, roots), *Syzygium aromaticum* (L.) Merr. & L.M. Perry (Myrtaceae) (flower buds), *Piper nigrum* L. (Piperaceae) (fruits), *Anacyclus pyrethrum* (L.) Lag. (Asteraceae) (roots), *Zingiber officinale* Roscoe (Zingiberaceae) (rhizomes), *Embelia ribes* Burm.f. (Primulaceae) (fruits), *Hyoscyamus niger* L. (Solanaceae) (seeds), *Cinnamomum verum* J.Presl (= *Cinnamomum zeylanicum* Blume) (Lauraceae) (bark)	Anthelmintic, skin diseases, malignant ulcers, syphilis	(S. Jain et al., 2010)
Triphala	*Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae), *Terminalia chebula* Retz. (Combretaceae)	Antioxidant, increase the resistance of the body against any infection	Ponnusankar et al. (2011)
Nimba arishta	*Azadirachta indica* A. Juss. (Meliaceae), *Terminalia chebula* Retz. (Combretaceae), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae), *Phyllanthus emblica* L. (Phyllanthaceae), *Woodfordia fruticosa* (L.) Kurz (Lythraceae)	Skin diseases, inflammation, immunomodulatory activity	Kroes et al. (1993)
Thiostanin	*Terminalia chebula* Retz. (Combretaceae), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae), *Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Commiphora mukul* (Hook. ex Stocks) Engl. (Burseraceae), *Plumbago zeylanica* L. (Plumbaginaceae), *Picrorhiza kurrooa* Royle ex Benth. [unresolved] (Plantaginaceae)	Anti-acne drug	Ghosh et al. (2011)
Takezama	*Azadirachta indica* A. Juss. (Meliaceae), *Phyllanthus emblica* L. (Phyllanthaceae), *Rubia cordifolia* L. (Rubiaceae), *Curcuma longa* L. (Zingiberaceae), *Berberis aristata* DC. (Berberidaceae), *Glycyrrhiza glabra* L. (Fabaceae)	Eczema, anti-inflammatory	Saple et al. (2007)
Finbid	*Piper nigrum* L. (Piperaceae), *Hemidesmus indicus* (L.) R. Br. ex Schult. (Apocynaceae), *Rubia cordifolia* L. (Rubiaceae), *Glycyrrhiza glabra* L. (Fabaceae), *Nardostachys jatamansi* (D. Don) DC. (Caprifoliaceae), *Mesua ferrea* L. (Calophyllaceae), *Saussurea costus* (Falc.) Lipsch. (Asteraceae), *Piper cubeba* L.f. [unresolved] (Piperaceae), *Withania somnifera* (L.) Dunal (Solanaceae), *Commiphora wightii* (Arn.) Bhandari (Burseraceae), detoxified hydragyrum, purified sulfur, purified yellow arsenic tri-sulphide, purified *Aconitum ferox* Wall. ex Ser. (Ranunculaceae), purified Soda Bi Boras, *Curcuma longa* L. (Zingiberaceae), *Phyllanthus emblica* L. (= *Emblica officinalis* Gaertn.) (Phyllanthaceae), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae), *Terminalia chebula* Retz. (Combretaceae)	Auto-immune skin disorders, fungal infection, psoriasis	Khan (2016)

the skin, followed by lichenification (thickening) and scaling of the skin. Eczema usually causes itching and burning of the skin. Eczema, also known as atopic dermatitis, is a condition where patches of skin become inflamed, itchy, red, cracked, and rough. Karodi et al. (2009) reported that *Rubia cordifolia* L. (Rubiaceae) is popular for its medicinal uses in eczema (Karodi et al., 2009). In this study, the alcohol extract and the *R. cordifolia* hydrogel were tested to evaluate the wound healing activity in an excision wound model in mice. The mice were divided into five groups of six animals each, group I–V was treated with gels with various extract concentrations (0.2%, 0.5%, 1%), once a day for 15 days, so as a result of the gel effect in terms of wound contractility, wound closure, wound surface reduction, tissue regeneration at the wound site, and histopathological features were significant in treated mice (Karodi et al., 2009). Mukhopadhyay et al. (2018), studied *Eclipta prostrata* (L.) L. (= *Eclipta alba* (L.) Hassk.), which is also thought to help treat eczema. *E. prostrata* shoot extract showed antibacterial activity against *E. coli, Staphylococcus aureus,* and anti-inflammatory effect on albino mice (Mukhopadhyay et al., 2018). Priyadarshi and Ram (2018) reported *Carica papaya* L. (Caricaceae) for the treatment of eczema. In this study, the three extracts (n-hexane, ethyl acetate, and ethanol extract) of *C. papaya* exhibited significant analgesic activity at all three dose levels (0.175, 0.35 and 0.70 mg/kg bw orally) compared to aspirin (standard drug) on a mouse model having acetic acid-induced pain (Priyadarshi and Ram, 2018).

Psoriasis: Psoriasis is a chronic inflammatory skin disease – cells build up and form scales and itchy, dry patches, mostly appearing on the scalp, elbows, knees, and lower back. It is an auto-immune problem. Schafer et al. (2010) demonstrated the broad anti-inflammatory activity of apremilast (a particular type of inhibitor used against psoriasis and psoriatic arthritis, marketed with the brand name Otezia) inhibited the production of multiple inflammatory mediators, including CXCL9, TNF-α, IFN-γ (monokines induced by MIG or IFN-γ), CXCL10 (IFN-γ induced protein of IP-10 or 10 kDa), IL-2, IL-12, IL-23, (MIP)-1α (macrophage inflammatory protein), (MCP)-1 (monocyte chemoattractant protein) and GM-CSF (granulocyte macrophage-colony stimulating factor) from PBMC (Schafer et al., 2010). In this study, in particular, the inhibition of IL-12, IL-23, and TNF-a production and the apremilast ability to inhibit psoriasis lesions *in vivo* suggests that this constituent might be a useful remedy in the treatment of psoriasis through a multifaceted mechanism (Schafer et al., 2010).

Schonthaler et al. (2009) investigated systemic VEGF (vascular endothelial growth factor) inhibition reducing psoriasis-like dermatitis. In this study, RT-PCR analyses was performed in the anti-VEGF–treated separated mouse epidermis and for VEGF in double knockout (DKO) mice administered with IgG, RNA levels were significantly reduced and for chemotactic proteins [S100A8 (also known as myeloid-related protein-8) and S100A9 (myeloid-related protein-14)] as well. RNA levels were reduced significantly in epidermal samples of anti-VEGF–treated mice (Schonthaler et al., 2009). Chen et al. (2017) demonstrated that Quercetin (QC) had anti-psoriasis effects in imiquimod (IMQ) induced mice, which is characterized by modulating many distinct signaling pathways, including the MAPK (Mitogen-activated protein kinase) signaling, the NF-κB pathway and the Nrf-2 pathway, so QC has significant potential value for the treatment of psoriasis and improving antioxidant and anti-inflammatory activity (Chen et al., 2017).

2.4. Medicinal plants in other countries and their negative healing effects

In Pakistan, the Manoor Valley, which is located about 320 km from the border of India, 48 plant species have been used in the treatment of skin disorders (Rahman et al., 2018). *Achyranthes aspera* L. (Amaranthaceae) is used in India for wound healing as well as for the treatment of eczema and wound healing in Pakistan. *Cedrus deodara* (Roxb. ex D. Don) G. Don (Pinaceae) is used in India as anti-inflammatory agent

Table 5
Herbal drugs and cosmetics products in dermatology.

Manufacturer	Product	Ingredients	Used as/against
Oziva	Anti-ageing food	Guava powder (*Psidium guajava* L., Myrtaceae), Sea Buckthorn powder (*Elaeagnus rhamnoides* (L.) A. Nelson = *Hippophae rhamnoides* L., Elaeagnaceae), Lemon powder (*Citrus limon* (L.) Osbeck, Rutaceae), Rose Petal powder (*Rosa* sp., Rosaceae), Orange Peel powder (*Citrus sinensis* (L.) Osbeck, Rutaceae), Spinach powder (*Spinacia oleracea* L., Amaranthaceae), Pink salt, Spirulina extract (*Arthrospira* sp., Microcoleaceae [Cyanobacteria]), Barley Grass powder (*Hordeum vulgare* L., Poaceae), Amla powder (*Phyllanthus emblica* L., Phyllanthaceae), Holy Basil powder (*Ocimum tenuiflorum* L. = *Ocimum sanctum* L., Lamiaceae), Pomegranate powder (*Punica granatum* L., Lythraceae), Strawberry powder (*Fragaria* × *ananassa* (Duchesne ex Weston) Duchesne ex Rozier, Rosaceae), Acai [Açaí] Berry powder (*Euterpe oleracea* Mart., Arecaceae), Ginger powder (*Zingiber officinale* Roscoe, Zingiberaceae), Green Tea extract (*Camellia sinensis* (L.) Kuntze, Theaceae), Cinnamon extract (*Cinnamomum* sp., Lauraceae), Acerola Cherry extract standardized to 17% Vitamin C (*Malpighia emarginata* DC., Malpighiaceae), Sesbania extract standardized to 0.5% Biotin (*Sesbania* sp., Fabaceae), Bamboo shoot extract standardized to 70% Silica (*Bambusa* sp., Poaceae)	Skin repair and regeneration, protects from UV damage
Khadi Natural	Face gold massage cream	Purified water, Sunflower oil (*Helianthus annuus* L., Asteraceae), Sheabutter (*Vitellaria paradoxa* C.F. Gaertn. (= *Butyrospermum parkii* (G.Don) Kotschy), Sapotaceae), Rose extract (*Rosa centifolia* L., Rosaceae), Olive oil (*Olea europaea* L., Oleaceae), Kokum butter (*Garcinia indica* (Thouars) Choisy, Clusiaceae), Wheatgerm oil (*Triticum aestivum* L. = *Triticum vulgare* Vill., Poaceae), Almond oil (*Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* var. *dulcis* (Borkh. ex DC.) Koehne), Rosaceae), Aloe Vera ext (*Aloe vera* (L.) Burm.f. (= *Aloe barbadensis* Mill.), Asphodelaceae), Licorice ext (*Glycyrrhiza glabra* L., Fabaceae), Beeswax (*cera alba*), Apple ext (*Malus domestica* Borkh. = *Pyrus malus* L., Rosaceae), Chamomile ext (*Matricaria chamomilla* L. = *Matricaria recutita* L., Asteraceae), Mulberry ext (*Morus alba* L., Moraceae, leaf), Ginkgo Biloba ext (*Ginkgo biloba* L., Ginkgoaceae), Rosemary ext (*Rosmarinus officinalis* L., Lamiaceae), Jojoba oil (*Simmondsia chinensis* (Link) C.K. Schneid., Simmondsiaceae), Grapeseed oil (*Vitis vinifera* L., Vitaceae), Sandalwood oil (*Santalum album* L., Santalaceae), Swarna Bhasma (Gold), Base Q.S.	Anti-ageing, reduce dead skin cells, skin fairness and glowing
	Facial massage gel	Rose extract (*Rosa* sp., Rosaceae), Geranium oil (*Pelargonium graveolens* L'Hér., Geraniaceae), Ashwagandha extract (*Withania somnifera* (L.) Dunal, Solanaceae), Demineralized water, E.D.T.A, Propyl Glycol, Gylcerine, Stabalized Aloe vera Gel (*Aloe vera* (L.) Burm.f., Asphodelaceae), Carbomer, Kathon Cg, Sodium Hydroxide, Xylitylglucoside, Anhydroxylitol, Xylitol, Aloe vera extract, Liquorice extract (*Glycyrrhiza glabra* L., Fabaceae), Fragrance, Color	Soothing skin
	Anti-wrinkle cream	*Crocus sativus* L., Iridaceae (Kumkuma), *Hydnocarpus wightianus* Blume, Achariaceae (Chaulmoogra), Wheat germ oil (*Triticum aestivum* L., Poaceae), *Prunus dulcis* (Mill.) D. A.Webb (= *Prunus amygdalus* Batsch), Rosaceae (Vatadha), *Santalum album* L., Santalaceae (Chandana), *Carica papaya* L., Caricaceae (Chirbhita), Shea butter (*Vitellaria paradoxa* C.F. Gaertn. (= *Butyrospermum parkii* (G. Don) Kotschy), Sapotaceae), Cocoa butter (*Theobroma cacao* L., Malvaceae)	Reduce fine lines, wrinkles, remove dark spots, protect the skin from sun damage
	Antiacne cream	Purified water, Sunflower oil (*Helianthus annuus* L., Asteraceae), neem extract (*Azadirachta indica* A. Juss., Meliaceae), Aloevera extract (*Aloe vera* (L.) Burm.f. (= *Aloe barbadensis* Mill., Asphodelaceae), olive oil (*Olea europaea* L., Oleaceae), Shea butter (*Vitellaria paradoxa* C.F. Gaertn. (= *Butyrospermum parkii* (G. Don) Kotschy), Sapotaceae), Wheatgerm oil (*Triticum aestivum* L. = *Triticum vulgare* Vill., Poaceae), Almond oil (*Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* var. *dulcis* (Borkh. ex DC.) Koehne), Rosaceae), Calendula extract (*Calendula officinalis* L., Asteraceae, flower), basil extract (*Ocimum basilicum* L., Lamiaceae), clove extract (*Syzygium aromaticum* (L.) Merr. & L.M.Perry = *Eugenia caryophyllus* (Spreng.) Bullock & S.G. Harrison, Myrtaceae), *Lavandula angustifolia* Mill. (= *Lavandula officinalis* Chaix, Lamiaceae) extract, *Symphytum officinale* L. (Boraginaceae) extract, *Cinnamomum verum* J.Presl (= *Cinnamomum zeylanicum* Blume, Lauraceae) extract, *Garcinia indica* (Thouars) Choisy (Clusiaceae), Jojoba oil (*Simmondsia chinensis* (Link) C.K. Schneid., Simmondsiaceae), grapeseed oil (*Vitis vinifera* L., Vitaceae), Tumeric extract (*Curcuma longa* L., Zingiberaceae), Teatree oil (*Camellia sinensis* (L.) Kuntze, Theaceae)	Acne, pimple, skin irritation
	Moisturizer cream	Purified Water, Sunflower Oil (*Helianthus annuus* L., Asteraceae), Sheabutter (*Vitellaria paradoxa* C.F. Gaertn. (= *Butyrospermum parkii* (G.Don) Kotschy), Sapotaceae), Beeswax (*cera alba*), Aloe vera Ext (*Aloe vera* (L.) Burm.f. (= *Aloe barbadensis* Mill., Asphodelaceae), Mulberry Ext (*Morus alba* L., Moraceae, Root), Olive Oil (*Olea europaea* L., Oleaceae), Kokum Butter (*Garcinia indica* (Thouars) Choisy, Clusiaceae), Almond Oil (*Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* var. *dulcis* (Borkh. ex DC.) Koehne), Rosaceae), Wheatgerm Oil (*Triticum aestivum* L. = *Triticum vulgare* Vill., Poaceae), Pineapple Ext (*Ananas comosus* (L.) Merr. = *Ananas sativus* Schult. & Schult.f., Bromeliaceae), Kastoori Methi (*Trigonella foenum-graecum* L., Fabaceae), Lavender Oil (*Lavandula angustifolia* Mill., Lamiaceae), Grapeseed Oil (*Vitis vinifera* L., Vitaceae), Basil Ext (*Ocimum basilicum* L., Lamiaceae), Saffron Ext (*Crocus sativus* L., Iridaceae), Sandalwood Oil (*Santalum album* L., Santalaceae)	Skin fairness, remove dead skin cells
Himalaya	Nourishing skin cream	Water (aqua), mineral oil, glycerin, cetyl alcohol, cetearyl ethylhexanoate, glyceryl stearate se, cetostearyl alcohol, triethanolamine, *Aloe vera* (L.) Burm.f. (= *Aloe barbadensis* Mill., Asphodelaceae) (aloe vera) leaf extract, glyceryl stearate & peg 100 stearate, phenoxyethanol, carbomer, *Pterocarpus marsupium* Roxb. (Fabaceae) (indian kino tree) wood extract, fragrance, *Withania somnifera* (L.) Dunal (Solanaceae)	Skin care

(*continued on next page*)

Table 5 (*continued*)

Manufacturer	Product	Ingredients	Used as/against
		(ashwagandha) root extract, *Centella asiatica* (L.) Urb. (Apiaceae) (gotu kola) extract, methylparaben, propylparaben, disodium EDTA.	
	Face wash	Water (aqua), ammonium lauryl sulfate, *Azadirachta indica* A. Juss. (= *Melia azadirachta* L., Meliaceae) (neem) leaf extract, cocamidopropyl betaine, sodium cocoyl glutamate & disodium cocoyl glutamate, glycerin, acrylates/c10-30 alkyl acrylate crosspolymer, *Curcuma longa* L. (Zingiberaceae) (turmeric) root extract, sodium hydroxide, phenoxyethanol, fragrance, methylchloroisothiazolinone & methylisothiazolinone, sodium metabisulfite, citric acid, disodium edta, tocopheryl acetate	Skin impurities, dead skin, excess oil
VLCC Natural Sciences	Active D pigmentation cream	Jojoba oil (*Simmondsia chinensis* (Link) C.K. Schneid., Simmondsiaceae), Carrot extract (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang., Apiaceae), Chamomile oil (*Matricaria chamomilla* L., Asteraceae), Licorice extract (*Glycyrrhiza glabra* L., Fabaceae), *Aloe vera* (L.) Burm.f. (Asphodelaceae)	Reduces pigmentation, lightens spots
COSMAX	Skin tiger cica gel cream	*Centella asiatica* (L.) Urb. (Apiaceae) extract (68%), Dipropylene Glycol, Glycerin, Butylene Glycol, Cyclopentasiloxane, Alcohol Denat., Water, Polyacrylamide,1,2-Hexanediol, Pentylene Glycol, *Citrus* × *aurantium* L. (Rutaceae) Bergamia (Bergamot) fruit oil, *Citrus limon* (L.) Osbeck (Rutaceae) (Lemon) Peel Oil, *Lavandula angustifolia* Mill. (Lamiaceae) (Lavender) oil, *Cymbopogon schoenanthus* (L.) Spreng. (Poaceae) Oil, *Cananga odorata* (Lam.) Hook.f. & Thomson (Annonaceae) flower oil, *Citrus aurantium* var. *dulcis* Hayne (Rutaceae) (Orange) peel oil, *Eucalyptus globulus* Labill. (Myrtaceae) leaf extract, Dimethicone, Cyclohexasiloxane, C13-14 Isoparaffin, Caprylyl Glycol, Dimethicone, Laureth-7,Hydrogenated Lecithin, Ethylhexylglycerin, Dimethicone/Vinyl Dimethicone Crosspolymer, Stearic Acid, Glyceryl Acrylate/Acrylic Acid Copolymer, Panthenol, Tocopheryl Acetate, Ceramide AP, Ceramide AS, Ceramide EOP, Ceramide NP, Ceramide NS, Cholesterol, Phytosphingosine, Propanediol, Sodium Hyaluronate Crosspolymer, Hydrolyzed Glycosaminoglycans, Sodium Hyaluronate, Benzyl Glycol, Hydrolyzed Hyaluronic Acid, Madecassoside, Asiaticoside, Asiatic Acid, Madecassic Acid, Hyaluronic Acid, Raspberry Ketone, Cetearyl Alcohol, Disodium EDTA	Sensitive, acne prone, and itchy skin
Biotique Advanced Ayurveda	Anti-acne gel	Chinai ghas (*Gelidium amansii* (J.V.Lamouroux) J.V.Lamouroux, Gelidiaceae [Rhodophyta]), Kuda (*Holarrhena pubescens* Wall. ex G. Don = *Holarrhena antidysenterica* (Roth) Wall. ex A. DC., Apocynaceae), Ghrit kumari (*Aloe vera* (L.) Burm. f. = *Aloe vera* var. *chinensis* (Steud. ex Baker) Baker = *Aloe vera 'indica',* Asphodelaceae), Kikkar gaund (*Acacia nilotica* (L.) Delile = *Acacia arabica* (Lam.) Willd., Fabaceae), Samundir Kai (*Gelidium amansii* (J.V.Lamouroux) J.V.Lamouroux, Gelidiaceae [Rhodophyta]), Himalayan Water Q.S.	Acne prone skin
	Anti-acne face pack	Jaiphal (*Myristica fragrans* Houtt., Myristicaceae), Pippli (*Piper longum* L., Piperaceae), Haldi (*Curcuma longa* L., Zingiberaceae), Chandan (*Santalum album* L., Santalaceae), Geru (Red ochre), Multani mitti (Fuller's earth), Kikkar gaund (*Acacia nilotica* (L.) Delile = *Acacia arabica* (Lam.) Willd., Fabaceae), Himalayan Water Q.S.	Skin redness, skin irritation
	Smooth skin lotion	Mandukaparni Panchang (*Centella asiatica* (L.) Urb., Apiaceae) extract, Surajmukhi Tail (Sunflower oil, *Helianthus annuus* L., Asteraceae), Sarso Tail (mustard oil, *Brassica* sp., Brassicaceae), Ashwagandha (*Withania somnifera* (L.) Dunal, Solanaceae) root extract, multi leaves extract, Mahua (*Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr., Sapotaceae) seed extract, Lotion base Q.S.	Dry and dehydrated skin care
	Sunscreen	Ghritkumari (*Aloe vera* (L.) Burm.f. = *Aloe barbadensis* Mill., Asphodelaceae), Methi (*Trigonella foenum-graecum,* Fabaceae), Madhu (Honey), Ankurit gehun (*Triticum aestivum* L. = *Triticum vulgare* Vill., Poaceae), Kusumbhi (*Carthamus tinctorius* L., Asteraceae), Lotion base Q.S.	Nourishes dry skin
Manuka honey	Moisturizing cream	*Aloe vera* (L.) Burm.f. = *Aloe barbadensis* Mill. (Asphodelaceae) leaf juice, Emulsifying Wax NF, Caprylic/Capric Triglyceride, Glycerol, *Leptospermum scoparium* J.R.Forst. & G. Forst. (Myrtaceae) (Manuka) Mel, *Cocos nucifera* L. (Arecaceae) (Coconut) Oil, *Theobroma cacao* L. (Malvaceae) (Cocoa) Seed Butter, *Theobroma cacao* (Cocoa) Seed Butter Deodorized, Carbomer, Tocopheryl Acetate, Cellulose Gum, Sodium Hyaluronate, Tapioca Natural, Titanium Dioxide, *Daucus carota* subsp. *sativus* (Hoffm.) Arcang. (Apiaceae) (Carrot) Seed Oil, DL-Panthenol, *Avena sativa* L. (Poaceae) (Oat) kernel flour, *Vitellaria paradoxa* C.F. Gaertn. = *Butyrospermum parkii* (G. Don) Kotschy), Sapotaceae (Shea) Butter, *Olea europaea* L., Oleaceae (Olive) Fruit Oil, (Hemp) Oil, Sodium Hydroxide, L-ascorbic acid, *Plumeria alba* L. (Apocynaceae) (Frangipani) Flower extract, Oat Amino Acids, Cehami (*Centipeda cunninghamii* (DC.) A. Braun & Asch., Asteraceae), MSM (MethylSulfonylMethane), Gluconolactone (and) Sodium Benzoate, Phenoxyethanol & Ethylhexylglycerin	Eczema, dry and itchy skin
Boroline	Antiseptic liquid	Neem (*Azadirachta indica* A. Juss. (Meliaceae), Turmeric (*Curcuma longa* L. (Zingiberaceae), Marigold, *Aloe vera* (L.) Burm.f. (Asphodelaceae), Cetrimide (*Centipeda cunninghamii* (DC.) A. Braun & Asch., Asteraceae), Chlorhexidine Gluconate	Prickly heat, itches and skin rashes
Cetaphil	Moisturizing cream	Purified Water, Polyglycerylmethacrylate & Propylene Glycol, Light Liquid Paraffin, Dicaprylyl Ether, PEG-5 Glyceryl Stearate, Glycerin, Dimethicone and Dimethicone, Cetyl Alcohol, Refined Almond Oil, Benzyl Alcohol, Tocopheryl Acetate, Acrylates/C10-30 Alkyl Acrylate, DIsodium Edetate, Sodium Hydroxide, ALL-RAC-Alpha Tocopherol	Skin allergies
Ilana	Brightening skin serum	*Citrus limon* (L.) Osbeck (Rutaceae) (lemon), *Carica papaya* L., Caricaceae (papaya), *Pelargonium graveolens* L'Hér. (Geraniaceae) (geranium), Wheat Germ Oil (Natural Vit E) (*Triticum aestivum* L. = *Triticum vulgare* Vill., Poaceae)	Hyperpigmentation and dark circles
Belif	Moisturizing cream	Water, Glycerin, Cyclohexasiloxane, Hydrogenated Polydecene, Dipropylene Glycol, *Macadamia ternifolia* F. Muell. (Proteaceae) Seed Oil, 1,2-Hexanediol, Bis-PEG-18 Methyl Ether Dimethyl Silane, Triethylhexanoin, Stearyl Alcohol, Glyceryl Stearate, Pentaerythrityl Tetraethylhexanoate, PEG-40 Stearate, *Saccharomyces/Viscum album* L., Santalaceae (Mistletoe) Ferment Extract, *Lactobacillus*/Soybean Ferment Extract	Dryness, loss of firmness and elasticity

(*continued on next page*)

Table 5 (*continued*)

Manufacturer	Product	Ingredients	Used as/against
		(*Glycine* max (L.) Merr., Facaceae), *Saccharomyces/Imperata cylindrica* (L.) Raeusch., Poaceae Root Ferment Extract, Cetearyl Alcohol, Ceteayl Olivate, Sorbitan Olivate, Hydrogenated Lecithin, Sorbitan Stearate, Stearic Acid, PEG-100 Stearate, Dimethicone, Dimethicone/Vinyl Dimethicone Crosspolymer, *Citrus trifoliata* L. = *Poncirus trifoliata* (L.) Raf., Rutaceae Fruit Extract, Panthenol, *Avena sativa* L. (Poaceae) (Oat) Kernel Extract, *Calendula officinalis* L., Asteraceae Flower Extract, *Nepeta cataria* L., Lamiaceae Extract, *Rubus idaeus* L., Rosaceae (Raspberry) Leaf Extract, *Baptisia tinctoria* (L.) Vent., Fabaceae Root Extract, *Stellaria media* (L.) Vill., Caryophyllaceae (Chickweed) Extract, *Alchemilla xanthochlora* Rothm. = *Alchemilla vulgaris* auct., Rosaceae Leaf Extract, *Viola tricolor* L., Violaceae Extract, *Rosa* × *damascena* Herrm., Rosaceae Flower Extract, *Filipendula ulmaria* (L.) Maxim. = *Spiraea ulmaria* L., Rosaceae Flower Extract, *Althaea officinalis* L., Malvaceae Root Extract, *Symphytum officinale* L. (Boraginaceae) Leaf Extract, *Trifolium pratense* L., Fabaceae (Clover) Flower Extract, *Achillea millefolium* L., Asteraceae flower Extract, *Euphrasia officinalis* L. [unresolved], Orobanchaceae Extract, *Thuja occidentalis* L., Cupressaceae Leaf Extract, *Menyanthes trifoliata* L., Menyanthaceae Leaf Extract, *Salix alba* L., Salicaceae (Willow) Bark Extract, *Chelidonium majus* L., Papaveraceae Extract, Urea, Hydroxyethylpiperazine Ethane Sulfonic Acid, Glycosyl Trehalose, Hydrogenated Starch Hydrolysate, Acrylates/C10-30 Alkyl Acrylate Crosspolymer, Carbomer, Xanthan Gum, Trisodium EDTA, Tromethamine, Frgrance, Citronnellol, Limonene, Napiers Original Formula, Napiers Moisture Formula, Fragrances of Natural Origin.	
Just Herbs	Anti-blemish gel	Indian madder (*Rubia cordifolia* L., Rubiaceae) ext. 0.5%, cinnamon (*Cinnamomum verum* J.Presl = *Cinnamomum zeylanicum* Blume, Lauraceae) ext. 0.2%, fumitory (*Fumaria officinalis* L., Papaveraceae) ext. 0.2%, chiraunji (*Buchanania cochinchinensis* (Lour.) M.R. Almeida = *Buchanania lanzan* Spreng., Anacardiaceae) ext. 0.2%, nutgrass (*Cyperus rotundus* L., Cyperaceae) ext.0.1%, nutmeg (*Myristica fragrans* Houtt., Myristicaceae) ext. 0.1%, holy basil (*Ocimum tenuiflorum* L. = *Ocimum sanctum* L., Lamiaceae) ext. 0.2%, lemon (*Citrus medica* L., Rutaceae) peel ext. 1%, tomato (*Lycopersicon esculentum* L., Solanaceae) ext. 1%, purified water (aqua), cetearyl olivate, aloevera (*Aloe vera* (L.) Burm.f. = *Aloe barbadensis* Mill., Asphodelaceae) leaf juice, vegetable glycerine, cold pressed grapeseed (*Vitis vinifera* L., Vitaceae) oil, cold pressed jojoba (*Simmondsia chinensis* (Link) C.K. Schneid., Simmondsiaceae) oil, octyldodecanol, sorbitan olivate, caprylyl glycol, potassium sorbate, gluconolactone, sodium gluconate, ethylhexylglycerin, natural preservative blend of herbs and essential oils.	Hyper pigmented skin

and in Pakistan against hair loss and psoriasis.

In India, it is common to use traditional drugs to treat dermatological conditions. It was found that most of the used healing plant species came from traditional healers, while those that were not readily available were bought on the market or collected directly in the wild. According to this, it was concluded that the management practice of dermatological healthcare in many research areas depends largely on wild-growing species of medicinal plants (Kumar et al., 2013; Dutta et al., 2021). Kumar et al. (2007) found, however, that the pharmacological research on Indian medicinal plants is very limited and a large number of plants used in tribal and folklore with enormous potential remains to add scientific information, complement or enrich local knowledge, and even advise locals on some possible side effects of plant use that may arise from clinical and pharmacobotanical studies, among others (Fig. 2) (Kumar et al., 2007).

However, these plants have been tested for generations within traditional medicine contexts and typically do not show significant side effects. Although, plant-induced cutaneous reactions can occur and hence this should provide the basis for the creation of a phytovigilance programme and reevaluation of how traditional medicine is utilised in the general population (Niang et al., 2015). It was found that some plant species used in Indian ethnodermatology can have also negative healing effects, e.g., *Jatropha curcas* L. (Euphorbiaceae), *Calotropis procera* (Aiton) Dryand. (Apocynaceae), *Lawsonia inermis* L. (Lythraceae) were found to induce contact eczema. *Momordica charantia* L. (Cucurbitaceae), *Azadirachta indica* A. Juss. (Meliaceae), and *Anacardium occidentale* L. (Anacardiaceae) were found to induce systemic eczema. *Vitellaria paradoxa* C.F. Gaertn. (= *Butyrospermum parkii* (G.Don) Kotschy), Sapotaceae was found to induce erythrodermic syndrome and erythrodermic psoriasis. The active ingredients in medicinal plants and herbs can often be as potent as many drugs made by pharmaceutical companies. This can cause unforeseen complications when combining active ingredients (Olisova et al., 2018).

Sharma et al. (2014) concluded that further preclinical, clinical, and toxicological studies on poorly developed plant species are necessary to see if there are chemical, microbiological, and/or clinical evidences, from a scientific perspective, of their effectiveness for those health disorders (Sharma et al., 2014). For example, the plants reported by Tharu community, namely, *Caesulia axillaris* Roxb. (Asteraceae), *Ehretia laevis* Roxb. (Boraginaceae), *Eulaliopsis binata* (Retz.) C.E. Hubb. (Poaceae), *Millettia extensa* (Benth.) Baker (Fabaceae), *Sida cordata* (Burm. f.) Borss. Waalk. (Malvaceae), and *Vanda tessellata* (Roxb.) Hook. ex G. Don (Orchidaceae) are advised to assess their potential for developing new medicines or skin care products (Sharma et al., 2014).

2.5. Sunscreen and transepidermal water loss (TEWL)

Modern pharmacological research showed that the extracts of safflower (known in India as Kusumbhi (*Carthamus tinctorius* L., Asteraceae)) have several physiological functions such as anticoagulant, vasodilating, antioxidant, melanin suppressive, immunosuppressive and antitumor (Lin et al., 2018). For this reason, it is a component of the sunscreen (Table 5) as usually the antioxidant activity presents high potential as a UVB sunscreen agent (Mukherjee et al., 2011) (Abdul Karim et al., 2014).

Topical application of soybean oil extracts (*Glycine* max (L.) Merr., Fabaceae) has been shown to reduce Transepidermal water loss (TEWL) of the skin of the forearm (Lin et al., 2018), thus *Lactobacillus*/Soybean ferment extract is an ingredient of moisturizing cream produced in India (Table 5). Soybean with pot marigold (*Calendula officinalis*), green tea (*Camellia sinensis*), turmeric (*Curcuma longa*), liquorice (*Glycyrrhiza glabra*), common chamomile (*Matricaria chamomilla*), *Punica granatu,* and *Vitis vinifera* are polyphenolic plants applied in cosmetology and dermatology as having anti-inflammatory, antiaging, skin-whitening and antimicrobial properties, and estrogen-like effects as well (Ratz-Łyko et al., 2015). Thus, these plants are also listed in the

Table 6
List of bacterial pathogens responsible for skin diseases in human and related symptoms.

SN	Disease	Bacterial pathogen	Signs and symptoms	Area
1.	Cellulitis	*Streptococcus pyogenes*	Painful, swollen and red infection	Occurs most often on the legs
2.	Folliculitis	*Staphylococcus aureus*	Red, swollen bumps	Hair follicles
3.	Impetigo	*Staphylococcus aureus, Streptococcus pyogenes*	Large blisters, yellow, crusted appearance	Face, arms, and legs
4.	Boils	*Staphylococcus aureus*	Red, tender bumps	Around hair follicle
5.	Erysipelas	*Streptococcus pyogenes*	Large, raised red patches on the skin	Face, legs and nasal passages
6.	Carbuncles	*Staphylococcus aureus*	Hair follicle, small scrape, or puncture	Skin surface, throat, and nasal passages
7.	Leprosy	*Mycobacterium leprae*	Discolored patches of skin, usually flat	Skin ulcers, nerve damage, and muscle weakness
8.	Ecthyma	*Staphylococcus aureus*	Lymph nodes become swollen and painful	Buttocks, thighs, legs, ankle and feet
9.	Erythrasma	*Corynebacterium minutissimum*	Skin lesions with pink patches and wrinkling that become red, then brown and scaly.	Armpits, groin, or between the toes
10.	Necrotising fasciitis	*Staphylococcus aureus, Haemophilus, Vibrio* sp., *Escherichia coli*, *Bacteroides fragillis*	Soft tissue and fascia	Any part of the body
11.	Spa pool folliculitis	*Pseudomonas aeruginosa*	Scattered small red itchy or tender bumps, itchy follicular papules and pustules	Any part of the body
12.	Thermal burn wounds	*Pseudomonas aeruginosa*	Blister, red skin, swelling	Populate beneath on protected layer
13.	Chronic leg ulcers	*Pseudomonas* spp.	Malodorous greenish superficial crust	Defect in the skin below the level of knee
14.	Ecthyma gangrenosum	*Pseudomonas aeruginosa*	Blisters, necrotic ulcers	Perineum and under arm pit

ethnodermatology of the Indian subcontinent.

3. Discussion

Various plant parts are used to treat dermatologic conditions in India: rhizomes, root, stem, flowers, fruit, bark, seed, seed oil, buds, latex, and whole plant parts (Fig. 3). Preparation methods and administration differ significantly. Topical administration takes the form of more complex preparations: decoctions, infusions, ointments, oils, poultices, tars, tinctures, unguents, or in a dried state (powder or ash) (Gilca et al., 2018). This review presents an addition to the existing knowledge of home remedies that are in current practice for the treatment of skin diseases in India. Most traditional medicines were prepared using water as a medium. The method of administration was topical and confined to the affected body part but also orally (in some cases). Analysis of how to use herbal preparations orally in diseases such as acne, carbuncles, leprosy, measles, urticaria, scabies, leucoderma, ringworm and dry skin conditions indicate that healers are perfectly familiar with the systemic course of the malady. In addition to pure herbal preparations, in some cases, the medicine was given along with milk, curd, ghee (clarified butter), coconut oil, or honey, for an enhanced impact (Manohar, 2012). For example, in the case of acne, Winkelman (2018) reported that aromatherapy, plant ingredients, and essential oils (plant extracts) are also important as potential agents in acne treatment (Winkelman, 2018), confirmed by bioactivity studies, preliminary evidence and small pilot clinical trials conducted outside of North America, predominantly in young adults. Sandalwood oil (*Santalum album* L., Santalaceae) is used as a remedy in many Asian countries for the treatment of inflammatory and skin eruptions as it possesses antimicrobial activity against *Staphylococcus aureus, S. epidermidis,* and *P. acnes* in concentrations of 0.06% and lower. In India, sandalwood oil is also an ingredient of face gold massage cream and moisturizer cream (Table 5). Sandalwood oil products were generally well tolerated, but burning, dryness, and stinging were reported as the most common treatment-related complaints (Winkelman, 2018). In Europe, however, other native (or other more popular cultivated) plants are used against acne, e.g., stinging nettle leaves (*Urtica dioica* L., Urticaceae), walnut husk (*Juglans regia* L., Juglandaceae), myrtle leaves (*Myrtus communis* L., Myrtaceae), chamomilla flowers (*Matricaria chamomilla* L., Asteraceae) and rose flowers (*Rosa* × *damascena* Herrm., Rosaceae) (Kılıç et al., 2019). The two latter plants are also used in Indian dermatology (Table 5), as these herbal extracts demonstrated strong antibacterial and anti-inflammatory activity in preliminary trials, the topical application of these botanical extracts can be good candidates for local acne treatment (Kılıç et al., 2019).

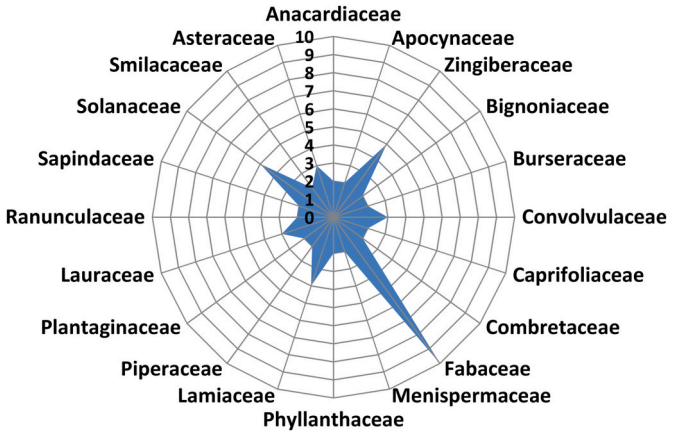

Fig. 4. Ayurvedic formulations in dermatology: how many species of the plant family are used (apart from single uses per family). The use of the Fabaceae family prevails significantly (ten species of this family are used in Ayurveda). It is followed by the following plant families: Solanaceae and Zingiberaceae (five species used in each family) and Lamiaceae (four species are used in Ayurveda).

Some Indian cosmetics listed in Table 5 (e.g., Antiacne cream, Active D pigmentation cream, or Anti-blemish gel) contain also jojoba oil (*Simmondsia chinensis* (Link) C.K. Schneid., Simmondsiaceae) that comprise a high content of wax esters makes it a good option for repairing dermatoses with an altered skin barrier, such as seborrhea, eczema or atopic dermatitis (AD) and acne (Fig. 9) (Lin et al., 2018).

Mediterranean plants can also be admixed with typical Indian plants as ingredients, e.g., Rosemary extract (*Rosmarinus officinalis* L., Lamiaceae) is also a component of the Face gold massage cream (Table 5). Namely, the addition of rosemary extract may have an anti-inflammatory effect in cosmeceutical or dermatological products, also confirmed by injection of rosemary extract which is not associated with skin irritation or inflammation in mice (Winkelman, 2018). Thanks to

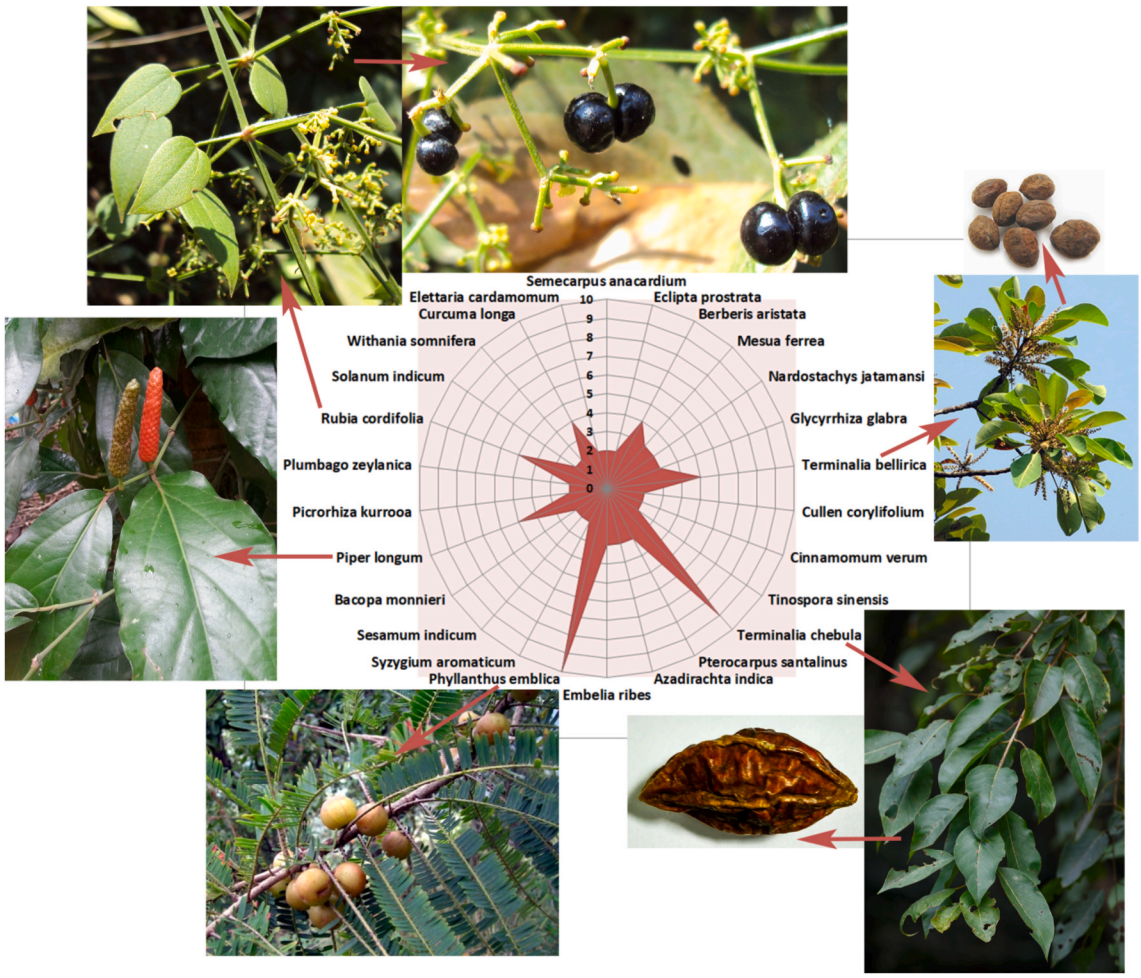

Fig. 5. Ayurvedic formulations in dermatology. Most often used plant species are: *Phyllanthus emblica* L. (Phyllanthaceae, bottom left), *Terminalia chebula* Retz. (Combretaceae, bottom and middle right), *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae, top and middle right), *Piper longum* L. (Piperaceae, middle left), and *Rubia cordifolia* L. (Rubiaceae, top left and middle). All photographs were reproduced on CC-BY-2.5, CC BY-SA 3.0, and CC BY-NC 4.0 licences.

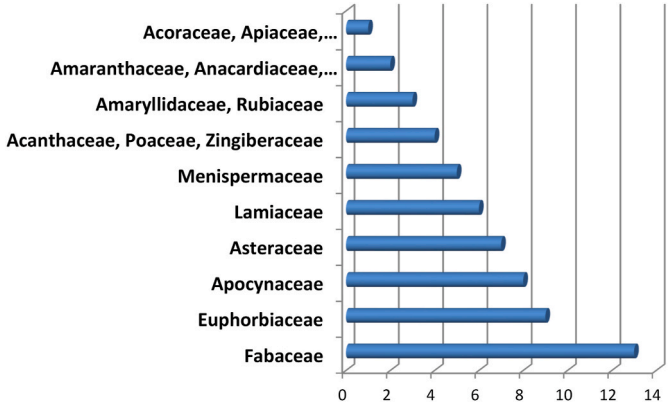

Fig. 6. Ethnodermatological drugs by plant families used in India. Plants of Fabaceae, Euphorbiaceae, Apocynaceae, Asteraceae, Lamiaceae prevail. X axis: number of plant species reported.

these properties, Rosemary is grown in many countries of the world.

Further comprehensive ethnobotanical and ethnopharmacological research could benefit the development of medicinal plants for skincare (Figs. 9 and 10) and treatment (A. Gupta et al., 2010). India offers a great deal of scope for ethnobotanical research on skin diseases, not only because of the richness of the flora but also because of the ancient culture of traditional medicine and hence the experience in applying these treatments (Jeeva et al., 2007).

Natural plant oils are widely used worldwide for skin care (as topical therapy) because they are usually readily available and are relatively inexpensive. Many natural oils contain specific compounds with antibacterial, anti-inflammatory, antioxidant, and anti-itch properties, which make them an alternative and attractive complement to the treatment of xerotic and inflammatory dermatoses related to skin barrier disorders (Vaughn et al., 2018). Plant oils applied topically may have different effects on the skin depending on their composition and the pathophysiological properties of the skin (Lin et al., 2018). In addition to the olive oil (*Olea europaea* L., Oleaceae) listed above, in Indian medicine, some plant oils are also commonly used: sunflower seed oil (*Helianthus annus* L., Asteraceae) in Antiacne cream and moisturizer cream (Table 5). Natural oils such as sunflower or sesame seed oil (*Sesamum indicum* L., Pedaliaceae) have been suggested to be a good option for promoting skin barrier homeostasis. In traditional Taiwanese medicine, sesame oil has been used to relieve inflammatory joint and wound pain and has shown chemopreventive effects in a two-step carcinogenesis mouse skin cancer model (Lin et al., 2018). In Ayurvedic Medicine, olive oil is an ingredient of Divya Kayakalpa Taila directed against skin disorders including ring worm, itching, sun burn, eczema, leucoderma, psoriasis, urticaria and allergy. Vipadikahara ghrita taila is used against skin lesions and contains sesame oil as well. However, in Ayurvedic Medicine, it was also found that excessive intake of sesame seed is the reason of obstinate skin state (Routh and Bhowmik, 1999). All of these ingredients are very helpful in skin treatment, but the most important

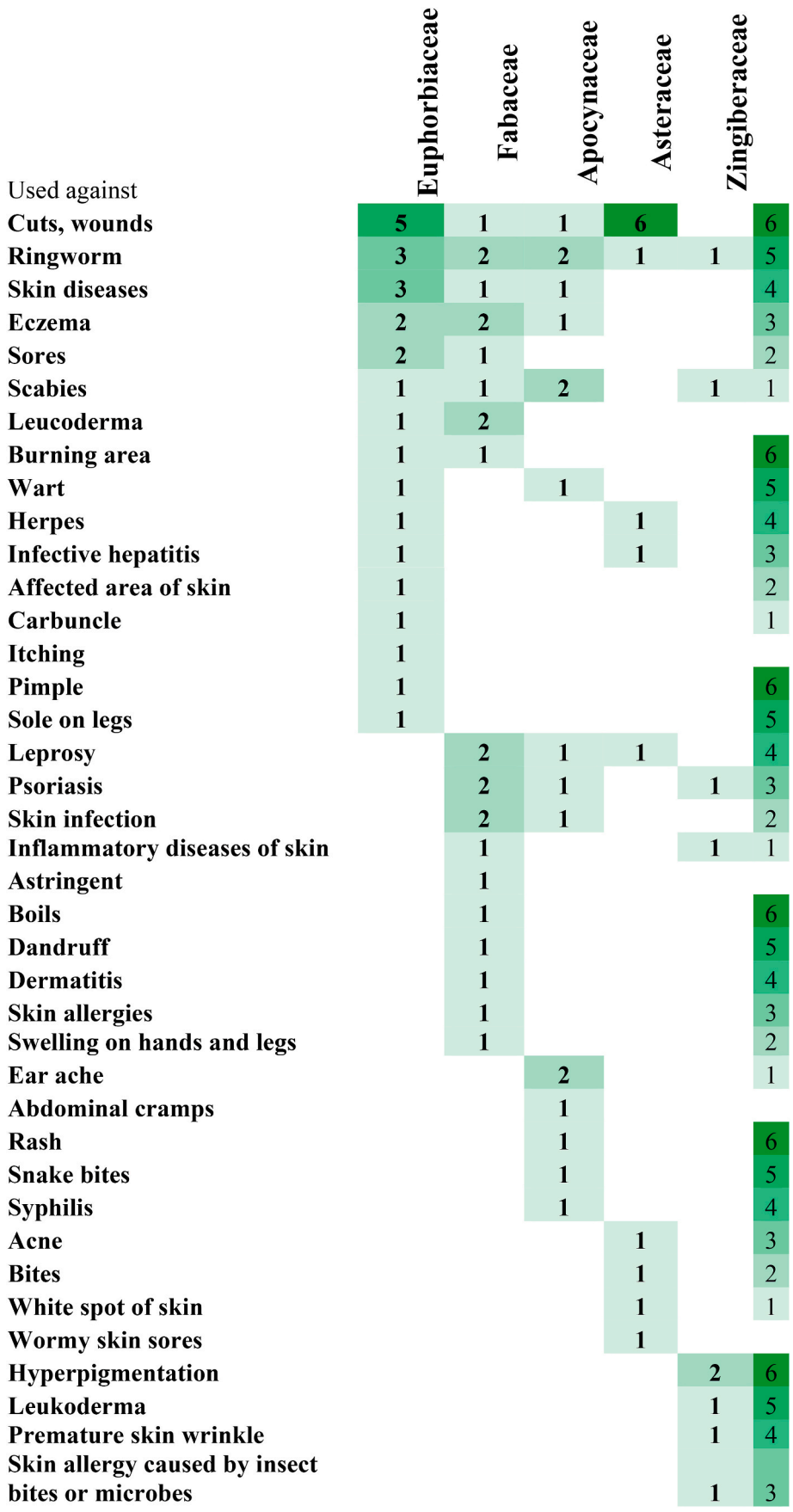

Fig. 7. Quantification of use reports by dermatological problems and five most used plant families in Indian ethnodermatology. Euphorbiaceae and Asteraceae plants are mostly used on cuts and wounds. Euphorbiaceae plant species are also reported against ringworm and skin diseases (generally).

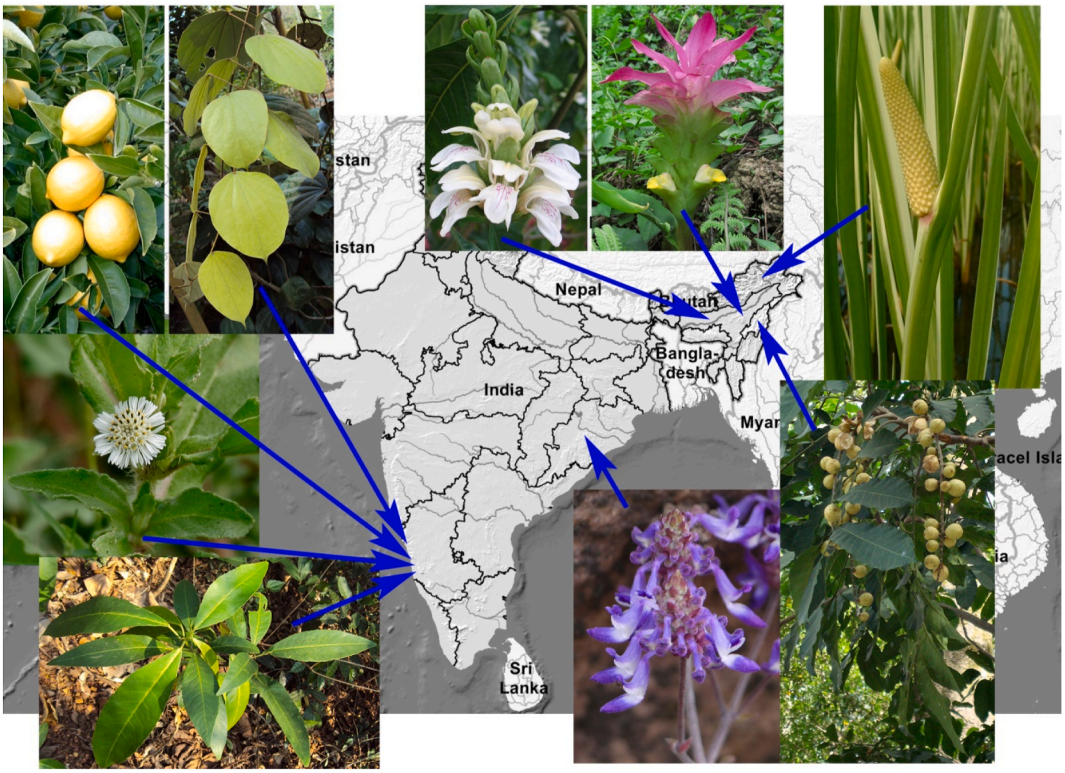

Fig. 8. Less commonly used plant species in Indian dermatology, only reported from specific regions of India. *Citrus limon* (L.) Osbeck, Rutaceae (top left), *Coscinium fenestratum* Colebr., Menispermaceae (second left), *Eclipta prostrata* (L.) L., Asteraceae (middle left), and *Croton persimilis* Müll. Arg., Euphorbiaceae (bottom left) are reported only in ethnodermatology of Coastal Karnataka. *Justicia adhatoda* L., Acanthaceae (middle top) and *Curcuma aromatica* Salisb., Zingiberaceae (second right) are only reported in ethnodermatology of Assam. *Acorus calamus* L., Acoraceae (top right) is only reported in ethnodermatology of Arunachal Pradesh. *Aphanamixis polystachya* (Wall.) R. Parker, Meliaceae (bottom right) is only reported in ethnodermatology of Nagaland. *Anisochilus carnosus* (L.f.) Wall., Lamiaceae (middle bottom) is only reported in ethnodermatology of Odisha. All photographs were reproduced with CC BY 2.0, CC BY-SA 3.0, or CC BY-SA 4.0 licences.

Ayurvedic issue to be considered is to tailor to the doshic imbalances and then learn how to correct the potential imbalances. Plant based carrier oils recommended for the skin according to the aromatherapeutic literature (Orchard and van Vuuren, 2019) are also used in Indian ethnodermatology (Tables 1–5); they are obtained from the following plant species: *Aloe vera* (L.) Burm.f. (Asphodelaceae), *Calendula officinalis* L. (Asteraceae), *Cocos nucifera* L. (Arecaceae), *Helianthus annuus* L. (Asteraceae), *Macadamia ternifolia* F. Muell. (Proteaceae), *Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* var. *dulcis* (Borkh. ex DC.) Koehne) (Rosaceae), *Simmondsia chinensis* (Link) C.K. Schneid. (Simmondsiaceae), *Triticum vulgare* Vill. (Poaceae), *Vitis vinifera* L. (Vitaceae). *V. vinifera* L. is also used in Ayurvedic formulations such as Chyawanprash, that accelerates wound closure (Lin et al., 2018). Thus, it is also included in Face Gold massage cream, anti-acne cream, anti-blemish gel, and moisturizer cream (Table 5). Direct topical application of grape seed oil to human skin has not yet been well researched, however, resveratrol has a direct antibacterial effect against pathogens, such as *Enterococcus faecalis, Pseudomonas aeruginosa* and *Staphylococcus aureus* (Lin et al., 2018).

The ethanol plant extract of *Cocos nucifera* L. (Arecaceae) was not confirmed for antimicrobial activity against *Propionibacterium acnes* and *Staphylococcus epidermidis* (Kumar et al., 2007), but topical application of virgin coconut oil is effective in the promotion of wound healing through much faster epithelization also important in the treatment of acne (Lin et al., 2018). Additionally, in veterinary dermatology, it was found that the use of a topical spray that contains essential oils of plant origin and fatty acids and compounds with antimicrobial properties (e.g., Manuka oil) may accelerate the resolution of pyoderma and shorten the duration of antibacterial treatment (Bensignor et al., 2016).

Traditional medicine is a promising alternative therapeutic strategy that can be used in oral and/or topical modes ahsinst various skin conditions. It highlights the significance of monoherbal as well as polyherbal formulations in the treatment of skin ailments. A pletheora of invstigations have been carried out to depict the multifaceted use of traditional medicines to treat different skin conditions.This information may be considered as valuable for dermatologists from the West to use such therapies as alternative or adjunct treatment strategies. In this review, an attempt has been made to present an ethnoderrmatological evidences across India with their efficacy, methods of preparation and administration. However, almost no literature was obtained describing the safety issues regarding possible contamination of the applied formulations. Moreover, more elaborate clinical placebo-controlled studies are needed for better understanding, systematic analysis and ramifications of the traditional dermatological applications in human.

However, it should be remembered that in Ayurvedic medicine there is no need to use preset formulations. There is no tailoring to each individual or looking at different individual nuances for each disease. Moreover, some evidence in Ayurvedic medicine is still only supported by *in vitro* testing, and *in vitro* evidence does not always successfully extend into the clinical realm. Therefore, extensive clinical studies are still required for most of these candidate plant extracts.

4. Concluding remarks

This review shows that the knowledge of herbal medicine is being used to treat different kinds of human skin disorders by local people. In the Indian subcontinent, complementary therapy for dermatological problems and treatment remains the main option for millions of people. This review of ethnobotanical dermatology in India confirms the belief that their analysis will accelerate the discovery of new, effective

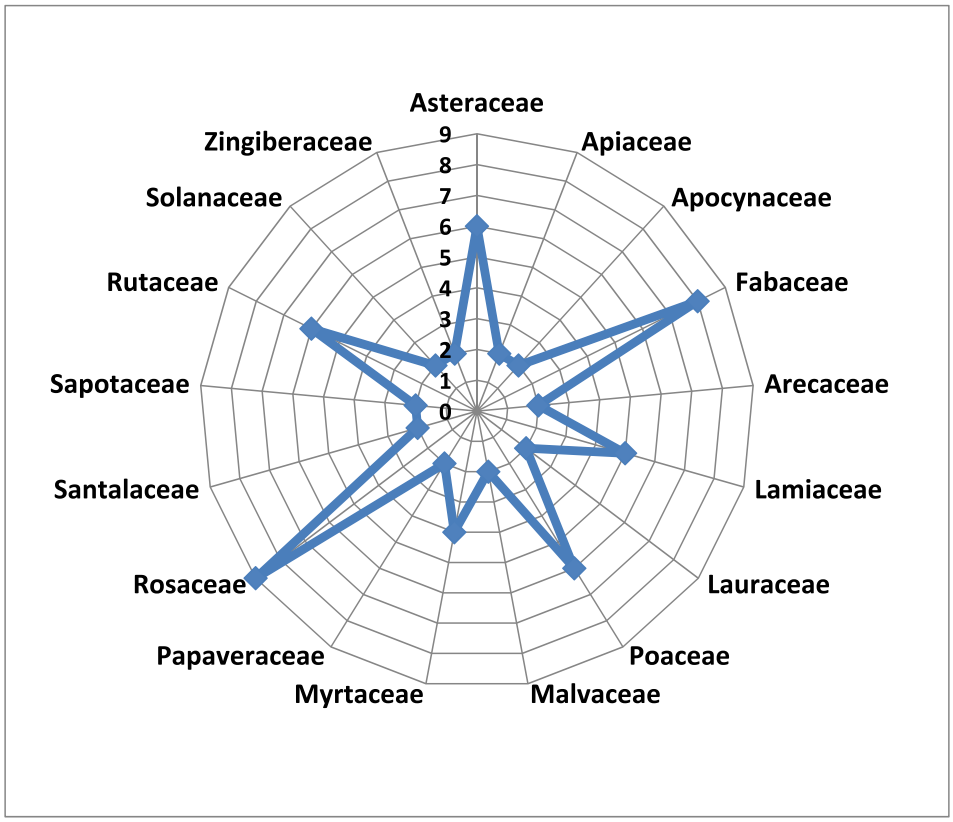

Fig. 9. Herbal drugs and cosmetics products in dermatology in India: the number of species of the plant family used. The utility of the Rosaceae family prevails (nine species of this family are used in cosmetics produced in India), followed by the following plant families: Fabaceae (eight species are used in cosmetics products in India) and Asteraceae, Poaceae, and Rutaceae (six species utilised from each family).

therapeutic agents for skin diseases. We conclude that the administration of extracts from most of these plant species is topical and few only are administrated orally. We also compiled the pharmacological activity of the extracts of the most cited plants against mice, bacterial and fungal pathogens, and human cells. As confirmed by Ariffin and Hasham (2016), more studies and clinical evidence are still required to determine if the identified species may contribute to skin condition treatment, particularly in atopic eczema. Today, ethnodermatology is a well-accepted international discipline and many new practices have been initiated in numerous countries. The topic is of supreme significance since many skin conditions are reportedly treated by the traditional medicines alongside the Western medications as alternative or in conjuction. Substantial evidence supports the efficacy of traditional formulations, but the safety issues are also needed to be remembered that may accompany the application of such medicines. We hope this article will further accelerate the development of this area to identify a new generation of natural human skin treatments that will help meet the growing consumer demand for safe, sustainable, and natural treatments. In this context, research on plants utilised in ethnodermatology in India and elsewhere should be intensified with further systematic andrigorous research needed for analyses and testing of traditional dermatological preparations that may eventually guide to formulate novel therapeutics against skin disorders.

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Availability of data and materials

The datasets generated in the current study are available in the Tables attached to this paper.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

CRediT authorship contribution statement

Uttpal Anand: Writing – original draft, Figures and Tables Preparation, Project administration, Attempt Reviewers and Editor Comments. **Champa Keeya Tudu:** Writing – original draft, Figures and Tables Preparation. **Samapika Nandy:** Writing – original draft, Figures and Tables Preparation. **Kumari Sunita:** Writing – original draft, Writing – review & editing, Figures and Tables Preparation, Attempt Reviewers and Editor Comments. **Vijay Tripathi:** Conceptualization, Formal analysis, Data curation, Writing – review & editing, Figures and Tables Preparation, Resources, Supervision. **Gary J. Loake:** Overall Proofreading. **Abhijit Dey:** Conceptualization, Formal analysis, Data curation, Visualization, Attempt Reviewers and Editor Comments, Resources, Supervision, Project administration. **Jarosław Proćków:** Conceptualization, Software, Formal analysis, Data curation, Writing – review & editing, Figures and Tables Preparation, Visualization, Attempt Reviewers and Editor Comments, Resources, Supervision, Funding acquisition.

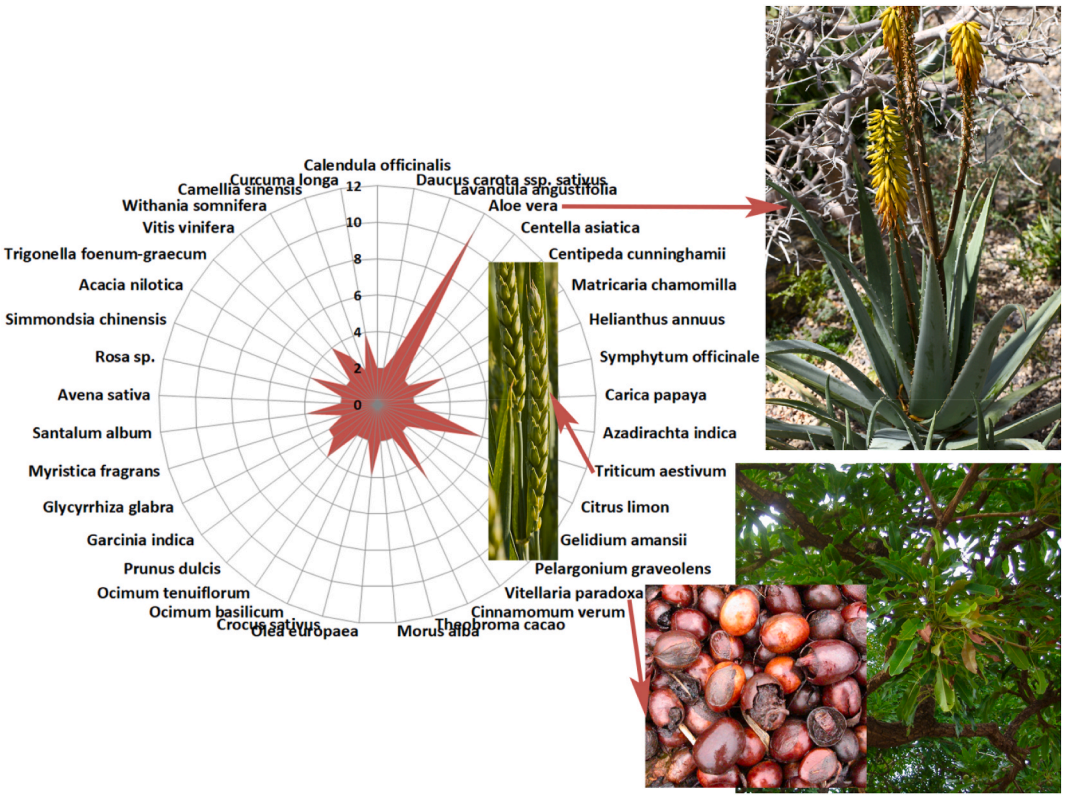

Fig. 10. Herbal drugs and cosmetics products in dermatology in India. Most frequently used plant species in cosmetics products are: *Aloe vera* (Asphodelaceae, top right), *Triticum aestivum* (Poaceae, centrally on the chart), and *Vitellaria paradoxa* (= *Butyrospermum parkii*) (Sapotaceae, both bottom). All photographs reproduced on CC BY 2.0, CC-BY-SA 2.5, and CC BY-SA 3.0 licences.

Declaration of competing interest

The other authors declared no potential conflicts of interests.

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Further reading

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