

Exploring Application of Herbal Remedies in The Management of Atopic Dermatitis: A Comprehensive Review

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Abstract:

Atopic dermatitis is a prevalent chronic skin condition, primarily affecting infants and young children, with approximately 200 million people worldwide suffering from it. The disease typically affects various body areas like the face, neck, chest, and limbs, and is often associated with emotional distress, sleep disturbances, and behavioral problems for both patients and their families. The treatment for atopic dermatitis can be costly and may have significant side effects. The review explores the current understanding of atopic dermatitis, including its epidemiology, pathophysiology, clinical features, and associated comorbidities. It also examines the effectiveness of conventional treatments and highlights the potential role of herbal medicine in managing the condition. By reviewing existing research from sources like Google Scholar and PUBMED, the paper discusses the use of various herbal remedies, such as Aloe vera, oats, sunflower, sandalwood, Curcuma longa, chamomile, rosemary, and coriander in the treatment of atopic dermatitis. The review emphasizes the clinical application of these herbal plants in managing atopic dermatitis and addressing the limitations of current treatment options. By focusing on the potential of herbal medicine, the paper aims to provide insights into alternative therapies that may offer safer, more accessible solutions for patients suffering from this challenging skin disorder.

Keywords: Atopic dermatitis, Pathophysiology, Herbal medicines, Alternative medical therapy.

Introduction

Atopic Dermatitis (AD), also referred as eczema, is a long-term inflammatory skin disorder that is identified by severe itching, redness, and dry patches. It is often referred to as "children's eczema" because it typically begins in early childhood and presents as itchy, inflamed dermatitis that can appear on the knees, elbows, cheeks, hands, or scalp. [1] This condition arises from an overactive immune response, elevated Th2 activity, and disruption of the skin barrier. AD affects approximately 15-20% of children and 1-3% of adults globally. Patients with AD may also face increased risks of various other physical and mental health conditions, such as asthma, allergic rhinitis, disrupted sleep, and food allergies. [2] AD, which features recurrent flare-ups and remission phases, is increasingly acknowledged as a significant public health concern linked to heightened risks of food allergies, asthma, and allergic rhinitis. The phenomenon is named as the 'atopic march' describes the progression of AD to other allergic diseases. [3]

Types of Atopic Dermatitis[4]

Subtype	Typical trigger	Key features	Common sites
Contact dermatitis	Chemicals, allergens	Redness, blistering	Hands, exposed areas
Neurodermatitis	Stress, anxiety	Itching, thickened skin	Neck, wrists
Nummular dermatitis	Unknown, environmental factors	Coin-shaped patches	Arms, legs
Dyshidrotic dermatitis	Allergy, sweat	Small blisters	Hands, feet
Stasis dermatitis	Venous insufficiency	Edema, ulcers	Lower legs
Seborrheic dermatitis	Sebaceous activity	Greasy scales	Scalp, face

Table No. 1 Types of Atopic Dermatitis

Figure 1: Dermatitis Effect on Different Body Part



Risk Factors and Causes of Atopic Dermatitis [5,6]

Atopic dermatitis may be triggered by several factors

Genetics: A history for conditions in the family such as eczema, asthma, or hay fever, along with mutations in the filaggrin gene, is strongly associated with AD and skin barrier dysfunction.

Immune System: The immune system plays a role in defending the body against diseases, viruses, and infections. In AD, an overactive or misdirected immune system can lead to skin irritation. Immune dysregulation, skin barrier impairment, and reduced production of natural moisturizing factors contribute to the condition's dryness and susceptibility to infection.

Environment: Environmental factors like climate, pollution, allergens, and irritants can exacerbate AD. Age is another important factor, with many cases improving as individuals grow older. Lifestyle factors such as stress, diet, and an imbalanced microbiome also contribute to the condition. People with AD are more likely to develop other atopic conditions and secondary skin infections.

Current Treatment for Atopic Dermatitis:[7]

Pharmacological treatment

Pharmacological treatment includes topical corticosteroids such as hydrocortisone 0.5%–1% and triamcinolone acetonide 0.1%, topical calcineurin inhibitors such as tacrolimus ointment and

pimecrolimus cream, topical phosphodiesterase-4 inhibitors such as crisaborole, roflumilast, and difamilast, and antihistamines such as hydroxyzine, cetirizine, loratadine, and diphenhydramine.

Systemic treatment

Systemic treatment includes oral corticosteroids such as prednisone, prednisolone, and methylprednisolone, immunosuppressants such as cyclosporine, methotrexate, azathioprine, and mycophenolate, biologic therapies such as dupilumab, lebrikizumab, and tralokinumab, JAK inhibitors such as baricitinib, cerdulatinib, delgocitinib, ruxolitinib, tofacitinib, and upadacitinib, oral JAK inhibitors such as gusacitinib, upadacitinib, tofacitinib, and abrocitinib, and phototherapy, with narrowband UVB being the most commonly used form.

Other therapies

Other therapies include regular skin care and bathing, moisturizers and emollients, humectants, mineral oils, olive oil, sorbitol, petrolatum, ceramides, glycerin, and alpha-hydroxy acids, along with patient education, treatment adherence, topical therapy guidance, dietary adjustments, bleach baths, meditation, yoga, exercise, and wet-wrap treatment.

Figure 2: Types of Therapies Other Than Conventional Method [8]

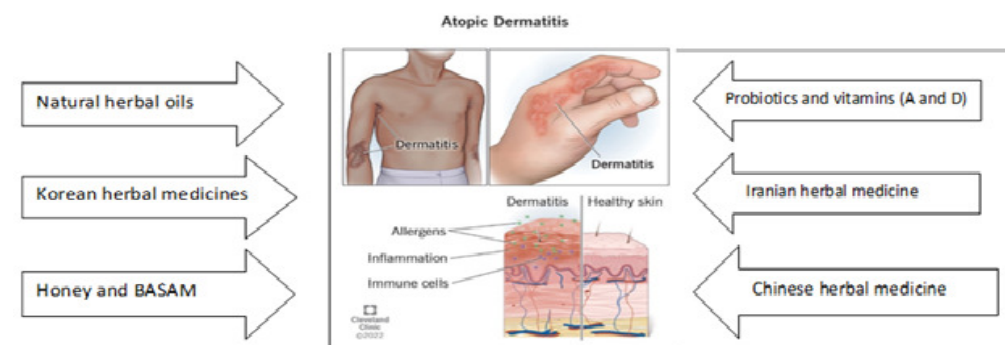
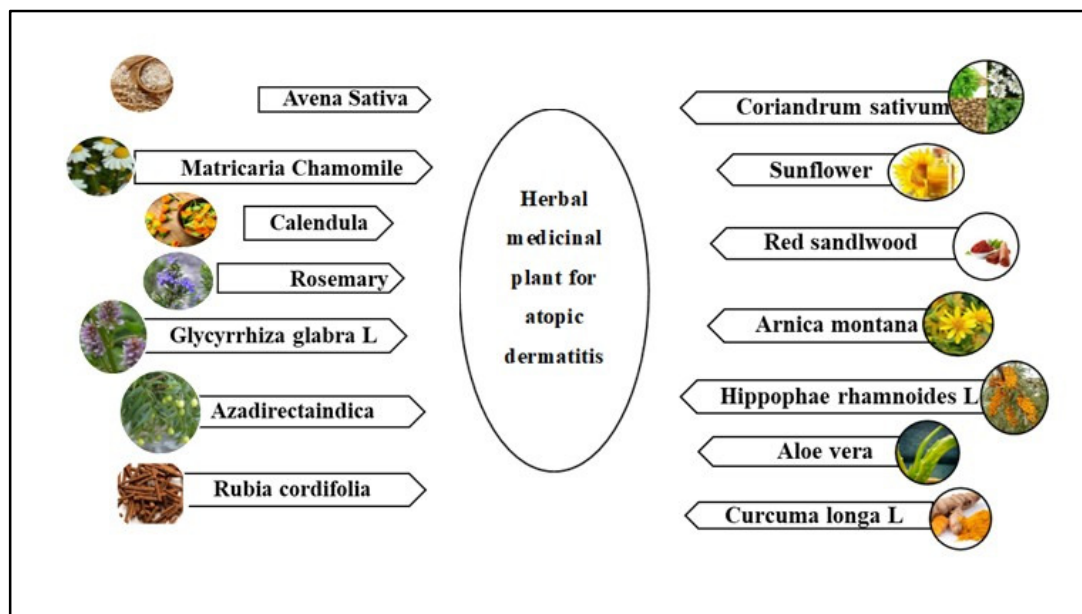


Figure3: Herbal medicinal plant for Atopic Dermatitis



Materials and Methods

A literature review commenced on online databases such as Web of Science, ScienceDirect, Google Scholar, and PubMed [5]. The review focused on research related to dermatitis in plant studies both in vivo and in vitro, as well as clinical studies. Keywords used in the search included terms related to the Ayurvedic Indian pharmacopoeia and pathophysiology or etiology of dermatitis.

Research Findings

Avena sativa (Oats) (Family: Poaceae)

The leaves, oat flour, or oat flakes of *Avena sativa* are used for their immunomodulatory, anti-inflammatory, and wound-healing properties. Active compounds like flavonoids, flavonolignans, triterpenoids, and saponins contribute to its effects. Oats are traditionally used to soothe minor skin irritations such as sunburn, eczema, and contact dermatitis. [9] [10]

Calendula officinalis (Pot Marigold) (Family: Asteraceae)

The flowers, leaves, petals, and seed oil of *Calendula* are used for various purposes. *Calendula* oil reduces inflammation and supports wound healing. The plant exhibits anti-inflammatory, antioxidant, antifungal, antiviral, anticancer, immunostimulant, and antibacterial properties. It is commonly used in the treatment of eczema. [11] The phytochemicals in *Calendula* include polysaccharides, triterpene alcohols, carotenoids, flavonoids, triterpenes, saponins, sterols, phenolic acids, and lipids, which contribute to its therapeutic effects. [12]

Salvia rosmarinus (Gulmehendi) (Family: Lamiaceae)

Rosemary is well-known for its aromatic properties. The leaves, oil, and flowers have antiviral, antibacterial, anti-inflammatory, antidepressant, antifungal, anticancer, and cardioprotective properties. Essential oils extracted from rosemary leaves are used in treating atopic dermatitis. The biological effects of rosemary are attributed to phenolic compounds such as rosmarinic acid, carnosol, and carnosic acid. [13] [14]

Aloe vera (Gwar Patha or Ghrit Kumari) (Family: Asphodelaceae Liliaceae)

Aloe vera is a stemless plant widely used for its skin-repairing and moisturizing properties. It is effective for treating inflammation, sunburn, low immunity, and diseases caused by oxidative stress.

Phytochemicals in Aloe vera include anthraquinones, tannins, sterols, salicylic acid, enzymes, saponins, and vitamins, which contribute to its wide range of therapeutic effects. [15] [16]

***Curcuma longa* (Turmeric) (Family: Zingiberaceae)**

The rhizome of Turmeric is the most commonly used part. Turmeric has long been used to treat gastrointestinal disorders, inflammation, diabetic wounds, and various other conditions. Its active compound, curcumin, as well as desmethoxycurcumin, bisdemethoxycurcumin, and other phytochemicals, contribute to its anticancer, anti-inflammatory, antioxidant, antimicrobial, and hepatoprotective properties. [17] [18]

***Matricaria chamomile* (Chamomile) (Family: Asteraceae)**

The flowers and essential oils from chamomile seeds are pharmacologically active parts. Chamomile has a variety of therapeutic effects, including antibacterial, anti-inflammatory, anti-allergic, and antioxidant properties. The primary phytochemicals in chamomile include phenolic acids, flavonoids, and coumarins. [19] [20]

***Arnica montana* (Wolf's Bane, Leopard's Bane) (Family: Asteraceae)**

The flowers, leaves, roots, seeds, and rhizomes of Arnica montana are used to treat eczema, tendon and joint pain, skin irritation, bacterial infections, and other inflammatory conditions. Active constituents such as carotenoids, resins, flavonoids, and volatile oils contribute to its therapeutic effects. [21] [22]

***Hippophaerhamnoides* L (Sea Buckthorn) (Family: Elaeagnaceae)**

The leaves, seeds, and berries of Hippophaerhamnoides have been used for treating dermatoses, eczema, psoriasis, burns, and digestive disorders. The plant is known for its anti-inflammatory and UV-protection qualities. Phytochemicals like flavonoids, lignans, terpenoids, and steroids are responsible for its pharmacological actions. [23] [24]

***Rubia cordifolia* (Indian Madder) (Family: Rubiaceae)**

Roots, rhizomes, and leaves of Rubia cordifolia are traditionally used to treat blood, skin, uterine, and urinary tract-related disorders. It is also used for psoriasis, dermatitis, and skin injuries. The plant contains anthraquinones, tannins, flavonoids, and other compounds that have neuroprotective, anti-inflammatory, and antioxidant effects. [25] [26]

***Glycyrrhiza glabra* L (Liquorice) (Family: Fabaceae)**

The root, rhizome, and leaves of Glycyrrhiza glabra are used to treat skin eruptions, including dermatitis and eczema. Glycyrrhiza glabra has a variety of medicinal properties, including antibacterial, anti-inflammatory, and antiviral actions. The active compounds in the root include saponins, flavonoids, and triterpenes, among others. [27] [28]

***Pterocarpussantalinus* (Rakta Chandana) (Family: Fabaceae)**

The heartwood and bark of Pterocarpus santalinus are used for their antipyretic, anti-inflammatory, and wound-healing properties. In Ayurveda, this plant is used to treat various skin diseases, including eczema. Phytochemicals such as alkaloids, phenols, flavonoids, and triterpenoids contribute to its therapeutic benefits. [29] [30]

***Helianthus annuus* (Sunflower) (Family: Asteraceae)**

The leaves, seeds, petals, and oil of the sunflower plant are used for treating inflammation, dermatitis, and cracked skin. They also help in improving dental hygiene and treating fungal infections. Sunflower contains minerals, vitamins, flavonoids, and carotenoids that contribute to its healing properties. [31] [32]

Azadirachta indica (Neem) (Family: Meliaceae)

Neem extracts from the leaves, bark, fruits, seeds, and roots are widely used to treat skin disorders such as dermatitis, acne, and fungal infections. Neem has antiviral, antifungal, antibacterial, and anti-inflammatory properties, with phytochemicals like limonoids, flavonoids, and tannins playing a key role in its efficacy. [33] [34]

Coriandrum sativum (Coriander) (Family: Umbelliferae)

The seeds, leaves, flowers, and fruit of *Coriandrum sativum* possess a variety of therapeutic effects, including antioxidant, anti-inflammatory, and anti-microbial properties. Phytochemicals in coriander include essential oils, tannins, flavonoids, and terpenoids, which contribute to its wide range of health benefits. [35] [36]

Plant name	In vivo studies	In vitro studies	Clinical study	Research findings	Reference
<i>Aloe vera</i>	Animal: Swiss albino Rat	----	-----	By inhibiting inflammatory cytokines like IFN- γ , IL-4, and IL-17A and boosting TJs to preserve epidermal barrier integrity, aloe vera in the form of polysaccharide reduced AD.	37
<i>Aloe vera</i>	-----	-----	30 adult females treated with dry-coated aloe vera gel gloves	Continual delivery of AV gel for a longer duration of time to the skin showed improved skin integrity with reduced fine wrinkling, erythema, and itching due to dryness was observed	38
<i>Avena sativa</i>	Animal Female SKH-1 hairless mice aged six weeks	The skin tissue's expression of cytokines linked to T cells was altered. Following treatment with OSE components, the in vitro irritation model showed decreases in cytokines linked to the type 1 response, specifically IFNG, TNF α , and IL-8. On the other hand, in vitro model cytokines associated with type 2 immunity, like IL-6	-----	Our findings revealed a reduction in the occurrence of CD4+ and CD8+ T-cells after OSE therapy.	39
<i>Avena sativa</i>	-----	-----	29 healthy female participants between the age of 18-60 years old.	Female participants who were benefited with colloidal oatmeal skin protectant lotion after 14 days evaluation time.	40
<i>Curcuma longa</i>	Animal: Female Balb mice	Assay techniques for enzyme-linked immunosorbents.	--	Lowering of TSLP, IL-13, and IL-17 levels in the AD- (DNCB) induced BALB/c mouse model was observed	41
<i>Curcuma longa</i>	--	----	150 subjects (12–80 years old with eczema applied Polyherbal cream with 5% curcumin as active	The active components in turmeric proved to provide clinically significant benefits to skin	42

			ingredient	health, dermatologists may consider offering this natural remedy to patients to improve certain skin diseases and overall skin health	
<i>Betula platyphylla</i>	The initial batch of male BALB/c mice (5 weeks, 19–20 g), SD rats (7 weeks, 250–300 g), and ICR mice (5 weeks, 25–30 g)	The enzyme-linked immunosorbent test (ELISA) and western blot analysis were used to assess the release of TNF- α , IL-6, and IL-8 secretions from HMC-1 cell lines.	--	The anti-inflammatory impact of <i>B. phytyphylla</i> on 2, 4-dinitrochlorobenzene (DNCB)-induced atopic dermatitis in mice was also assessed. Scratching behaviors were investigated by generating scratching using 48/80 or histamine.	43
<i>Calendula officinalis L</i>	Animal: female Balb/c mice	human keratinocytes - HaCaT cells and RAW-264.7 cells	-----	A decrease in IL-6 and tumor necrosis factor in human keratinocytes cells and nitric oxide production was inhibited in RAW 264.7 cells. In vivo studies state that mast cell infiltration and epidermal thickness were reduced.	44
<i>Arnica montana</i>	T cell receptor (TCR) transgenic P14 mice, C57BL/6 (B6), Balb/c and (18)	Dendritic cells	-----	The plant extract and sesquiterpene were found to possess both contact dermatitis inducing as well as suppressing actions in different mouse models and in dendritic cells. Prominent inhibitory action was through NF- κ B and IL-12.	45
<i>Rosemary</i>	Animal: model mice Yeo et al.'s in vivo investigation, which emphasizes the anti-inflammatory function of carnosol in UVB-induced skin damage in AD-affected mice, provides additional support for these molecular processes.	The administration of four herbal extracts, including Rosmarinus officinalis, decreased atopic lesions in a mouse model of atopic dermatitis, thereby preventing the impact of NGF on neuritic outgrowths in lesional skin.		In HR1 mice, the topical administration of carnosol had an anti-inflammatory impact on UVB-induced skin inflammation, inhibiting erythema, epidermal thickness, and inflammatory response.	46
<i>Matricaria chamomilla</i>	Balb/c mice	--	--	Biopsy results and reduced scratching behaviour suggest that 7% extract of <i>Matricaria chamomilla</i> can be effectively used to treat lesions of AD	47
<i>Hippophaerham noides L.</i>	Animal: 6-week-old female BALB/c mice	HaCaT cells are human keratinocytes.		This study resulted in the preventive effects on 2,4-dinitrochlorobenzene (DNCB)-induced AD mice models when	48

				applied topically. Similarly, results on HaCaT cells were also promising.	
<i>Glycyrrhiza glabra L</i>	Animal: Four sets of nine female BALB/c mice between the ages of six and eight weeks, weighing between 18 and 21 g, were created.	mouse mast cell line (P815 cells, and rmHMGB1)	---	Changed serum IgE levels (HMGB1) expression, nuclear factor (NF)- κ B and <u>cytokines</u> responsible for inflammation were observed in both in vitro and in vivo studies.	49
<i>Coriandrum sativum</i>	Animal: rat and mice	Human: bronchial epithelial cells, RAW264.7 macrophage cells		Different inflammatory mediators were suppressed. Suppression of IL-1 β , IL-6, and TNF- α IFN- γ , IL-4, and IL-13 and IgE by <i>C. sativum</i> extract, oil, and fractions was reported. Similarly, <i>C. sativum</i> showed promising wound healing effects in second-degree burn wounds in the rat model	50
<i>Azadirachta indica</i>	Animal: Swiss albino mice and adult albino rabbits	Human: skin keratinocytes HaCaT cell line		Current study investigated antibacterial effects of <i>Azadirachta indica</i> formulation of which <i>azadirachta indica</i> is one of the ingredient in in vitro and in vivo studies	51
<i>Pterocarpus santalinus</i>	Animal: Four-week-old NC/Nga female mice	Rat basophilic leukemia-2H3 mast cells,	---	The study revealed the effects of PSE on the suppressed production of TNF- α and IL-4, major cytokines in AD.	52
<i>Helianthus annuus</i>	Animal: Balb/c female <u>mice</u>	Jurkat T cells and Raji B cells	---	Restoration of thickened and enlarged ear tissue through regulation of the major <u>inflammatory cytokines</u> that are increased by AD	53
<i>Red sandalwood</i>	Animal: NC/Nga mice	Rat basophilic leukemia-2H3 mast cells	---	A inhibited epidermal thickness and intradermal inflammatory cell infiltration were observed in histopathological analyses.	54

Table No.2 Reported in vivo, in-vitro, and Clinical studies of the herbs for Atopic Dermatitis

Results and Discussion:

Medicinal plants such as *Azadirachta indica*, *Pterocarpus santalinus*, *Rubia cordifolia*, *Curcuma longa*, *Aloe vera*, *Glycyrrhiza glabra*, and culinary herbs like *Helianthus annuus* and *Coriandrum sativum* have been identified as potential treatments for atopic dermatitis (AD). This study aimed to gather information on the chemical components and pharmacological properties of these herbs used for AD treatment. The research also focused on the experimental and clinical studies evaluating the effectiveness of plant extracts and phytoconstituents against AD. The results indicate that these plants possess significant anti-inflammatory, antimicrobial, antioxidant, and skin-rejuvenating qualities. These attributes suggest that using these herbs in combination could offer added benefits, potentially

providing a safer alternative with fewer side effects compared to conventional treatments like corticosteroids, calcineurins, and biologics for AD.

Conclusion:

This review underscores the therapeutic potential of medicinal plants in managing atopic dermatitis. Many individuals opt for plant-based solutions to address skin conditions due to their safety, cost-effectiveness, and ability to reduce inflammation. These herbs are effective in alleviating skin issues, such as preventing eruptions, reducing lichenification, and combating complications like microbial infections and sleep disturbances. Additionally, they help reduce the economic burden of conventional treatments and prevent social isolation in severe AD cases. The review also highlights clinical trials and in vivo experiments supporting the use of these herbs, demonstrating their ability to regulate skin barrier function, permeability, and inflammation. Some plant extracts even serve as moisturizing agents. The findings call for further clinical evaluation of herbal formulations to address ongoing challenges in AD treatment.

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