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A Brief Review of Medicinal Plants with Anti-asthmatic Properties

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Abstract

Asthma is a chronic, non-communicable respiratory disease affecting millions worldwide, particularly in industrialized countries. It results from interactions between genetic predisposition and environmental factors. Asthma symptoms arise from the release of endogenous mediators like histamine, nitric oxide, and chemokines, leading to airway inflammation. Nutraceutical therapy, utilizing medicinal plants, is one treatment approach. Several plants, including *Anogeissus acuminata*, *Alnus hirsuta*, *Argemone mexicana*, *Biophytumsensitivum*, *Momordica dioica*, *Ginkgo biloba*, *Curcuma longa*, *Piper betel*, *Euphorbia hirta*, *Camellia japonica*, *Echinacea angustifolia*, *and Allium* species, possess antimicrobial properties and show therapeutic potential in asthma management.

Keywords: Asthma, Anti-asthmatics, Airway disorder, Medicinal Plants, Herbal plants

Introduction

Asthma is a chronic inflammatory airway disorder involving mast cells, T-lymphocytes, eosinophils, epithelial cells, and neutrophils [1, 2]. It causes airway narrowing and alters levels of eosinophils, mast cells, lymphocytes, and cytokines. Asthmatics typically have elevated IgE levels, which, upon antigen interaction, trigger inflammatory reactions, releasing mediators like histamine and prostaglandins that cause airway smooth muscle contraction [3-5].

This respiratory condition is characterized by airway inflammation, intermittent airflow obstruction, and bronchial hyper-responsiveness. Key symptoms include coughing, wheezing, and shortness of breath, often exacerbated by allergens or viral infections. Asthma's prevalence and severity result from a complex interplay of genetic and environmental factors. Despite treatment advances, disparities in asthma care persist, affecting diagnosis, treatment, and patient education across demographics [6].

Epidemiology

Asthma, an obstructive pulmonary disease, affects approximately 300 million people worldwide [7, 8], with projections of an additional 100 million by 2025 [9]. In the USA, the annual cost of asthma is about $56 billion. Airway inflammation plays a significant role in asthma pathophysiology [10], with chronic airway remodeling mediated by chemical mediators [11]. Disease progression is exacerbated by airway narrowing [12, 13]. Asthma management aims to reduce prevalence and mortality, improve lung function and quality of life, normalize physical activity, reduce medication dependency, and alleviate symptoms [14].

Global asthma prevalence is estimated at 260 million individuals [15], with rates varying from 3.4% to 33% across different countries [16]. Despite declining death rates between 2001 and 2015, asthma still accounts for approximately 420,000 deaths annually [17]. Factors contributing to asthma-related deaths include under-prescription of inhaled glucocorticoids and limited access to emergency or specialist care.

In the United States, about 25 million people have asthma. Prevalence varies by demographics: boys have higher rates than girls under 18, while adult women are more affected than men. Black individuals show higher prevalence (10.1%) compared to White individuals (8.1%). Hispanic Americans generally have lower prevalence (6.4%), except for Puerto Ricans (12.8%).

Underrepresented minorities and those below the poverty line experience the highest asthma incidence and related morbidity and mortality.

Asthma mortality rates in the United States have declined consistently, mirroring global trends. The current mortality rate is 9.86 per million, down from 15.09 per million in 2001. However, racial disparities persist, with Black patients experiencing consistently higher mortality rates compared to White patients. CDC data from 1999 to 2016 show asthma death rates per 1 million persons as follows: 16.32 for adults aged 55 to 64, 9.95 for females, and 9.39 for non-Hispanic or Latino individuals and a significantly higher 25.60 for Black patients. [18].

Types of Asthma

Asthma is classified into two primary types: extrinsic and intrinsic. Extrinsic asthma, comprising 10-20% of cases, is precipitated by allergic reactions to environmental triggers such as house dust, animal dander, or specific foods. Intrinsic asthma, accounting for 50-60% of cases, is attributed to genetic predisposition, structural abnormalities, infectious agents, and various physiological and psychological factors [6,19]. While a definitive cure for asthma remains elusive, management strategies include pharmacological interventions and phytotherapeutic approaches, with natural remedies often employed as adjunctive therapies [20].

Asthma exacerbations are characterized by pathophysiological alterations in the airways, resulting in airflow limitation, recurrent symptomatology, reversible bronchial obstruction, and bronchospasm. The clinical presentation of asthma typically involves airway inflammation, coryza, cough, wheezing, chest constriction, and dyspnea. Symptom manifestation varies among patients but may include expiratory wheezing, nocturnal dyspnea-induced sleep disturbances, thoracic tightness, coughing, and chest discomfort. These symptoms frequently exacerbate nocturnally, in response to physical exertion, and in the early morning hours.

Causes of asthma

Asthma etiology is postulated to involve a complex interplay of environmental and genetic determinants, which modulate disease manifestation and severity. Environmental triggers encompass cold air exposure, allergen inhalation, smoke, and chemical irritants. Genetic predisposition is a significant factor, with familial clustering observed; concordance studies in monozygotic twins demonstrate a 25% probability of asthma development in the co-twin when

one is affected. Current genomic research has identified approximately 25 genes associated with asthma susceptibility. Comorbid atopic conditions, including atopic dermatitis and allergic rhinitis, are recognized as risk factors for asthma development [21].

Diagnosis

Diagnosis can be made through physical examination, where a doctor checks breathing with a stethoscope, breathing tests that measure airflow into and out of the lungs, and spirometry, which measures the speed of air.

Asthma: classification

Asthma is classified into three categories: mild persistent, where symptoms last more than two weeks but are not daily; moderate persistent, where symptoms occur daily; and severe persistent, where symptoms occur several times every day and worsen significantly at night [22].

Treatment of asthma

Asthma management focuses on symptom control rather than curative intervention. Pharmacological approaches for acute symptom relief include various agents, which may be associated with adverse effects. Rapid-acting bronchodilators, administered via nebulization or inhalation, anti-inflammatory medications, anticholinergics, and biological therapies constitute the primary armamentarium for acute asthma management [23]. To mitigate potential adverse effects associated with conventional therapies, adjunctive use of phytotherapeutic agents has been explored. Several medicinal plants have been investigated for their potential therapeutic effects in asthma, including *Anogeissus acuminata, Alnus hirsuta, Argemone mexicana, Biophytumsensitivum, Momordica dioica, Ginkgo biloba,* and *Aerva lanata.*

Traditional plants with anti-asthmatic properties

Anogeissus acuminata

Anogeissus acuminata (Combretaceae) is indigenous to Southeast Asian regions, including Pakistan, Bangladesh, and India. Ethnomedicinal applications of this species encompass the management of cardiovascular disorders, notably hyperlipidemia. Additional traditional uses include the treatment of diabetes mellitus, dermatological conditions, gastrointestinal disturbances, smooth muscle dysfunction, odontalgias, oral lesions, wound healing, diarrhea, dysentery, cough, burns, and ophidian envenomation. Documented pharmacological properties of *A. acuminata* include hepatoprotective effects, wound healing promotion, amelioration of diabetic nephropathy, antioxidant activity, anti-HIV potential, antibacterial efficacy, protein tyrosine phosphatase inhibition, and thrombolytic activity [24].

Bioactive Compounds of *Anogeissus acuminata*

A. acuminata represents a rich reservoir of bioactive constituents contributing to its diverse therapeutic properties. Tannins, flavonoids, triterpenoids, and polyphenols constitute the primary phytochemical components. Tannins, predominantly found in the bark and foliage, have demonstrated efficacy in the management of diarrheal disorders and wound healing. Flavonoids, functioning as free radical scavengers and anti-inflammatory agents, potentially mitigate oxidative stress and inflammatory processes. The presence of triterpenes, notably betulinic acid, confers antimicrobial and antineoplastic properties to *A. acuminata*. Polyphenols, recognized for their potent antioxidant activity, contribute significantly to the plant's free radical scavenging capacity, potentially supporting systemic health and chronic disease prevention. Additionally, these compounds modulate the secretion of antimicrobial proteins, potentially enhancing host defense against bacterial and fungal pathogens. The synergistic effects of these bioactive constituents underpin the traditional applications of *A. acuminata* in the management of respiratory, gastrointestinal, dermatological, and dental conditions.

Medicinal Uses

Anogeissus acuminata has an extensive history of ethnomedicinal applications. Various plant components, including bark, foliage, and wood, are utilized for their therapeutic properties. The bark and leaves are traditionally employed topically to promote wound healing and prevent infection in cutaneous lesions. The species has demonstrated potential antidiabetic effects in diabetes mellitus management. A decoction prepared from the bark is traditionally utilized in the treatment of respiratory tract infections, including cough, common cold, and bronchitis. In certain cultures, *A. acuminata* twigs serve as natural dental hygiene implements, exploiting their antimicrobial properties to maintain oral health. The decoction is purported to have expectorant and mucolytic properties. Cardiovascular applications include the management of hyperlipidemia. Additional ethnomedicinal uses encompass the treatment of dermatological conditions, gastrointestinal disorders, smooth muscle dysfunction, odontalgias, oral lesions, diarrhea, dysentery, and thermal injuries. The bark and leaves are employed to support digestive function, addressing conditions such as dyspepsia, gastric ulceration, and constipation. In Andhra Pradesh, the leaves have been utilized in traditional and tribal medicine for the management of inflammatory disorders[25].

Argemone mexicana

An aqueous extract of *A. mexicana* stem, administered intraperitoneally at a dose of 50 mg/kg, has demonstrated antiallergic and antistress properties in models of milk-induced leukocytosis and eosinophilia [26]. The plant is recognized for its antioxidant and anti-inflammatory effects [27].

Allium cepa (Onion)

Allium cepa L., commonly known as onion, is the most extensively cultivated species within the genus *Allium* [28]. *A. cepa* extract, administered at doses of 35, 70, and 140 mg/kg, has demonstrated significant reductions in IL-4, IgE, and oxidative stress markers, while concomitantly elevating antioxidant parameters (SOD, CAT, and thiol), IFN-γ, and the IFN-γ/IL-4 ratio in an asthmatic rat model, compared to 1.25 µg/mL dexamethasone. Additional research has elucidated the potential therapeutic efficacy of *A. cepa* extract in asthmatic murine models, evidenced by reductions in bronchoalveolar lavage fluid (BALF) levels of IL-13, IL-5, and IL-4. Shakeri et al. demonstrated the anti-asthmatic properties of this plant at a concentration of 0.7

mg/mL, as evidenced by the inhibition of MDA, NO2, NO3, and total protein in a rat model [29]. Furthermore, the extract has been shown to reduce bronchial mast cell numbers in an ovalbumin-induced asthma model at a dose of 140 mg/kg [30].

Alnus hirsuta (Spach)

In Eastern Asian traditional medicine, compounds derived from this member of the *Betulaceae* family are employed in the management of alcoholism, diarrhea, and hemorrhage. Lee et al. conducted a comparative study using an ovalbumin-induced murine asthma model to evaluate *Alnus hirsuta* against dexamethasone (3 mg/kg). The investigation demonstrated that *A. hirsuta*, at a concentration of 50 mg/kg, attenuates mucus hypersecretion and airway inflammation [31].

Asystasiagangetica T. Adams (Acanthaceae)

Asystasiagangetica (A. gangetica) is utilized in various regions of Nigeria for asthma management. Akah et al. investigated the anti-asthmatic properties of hexane, ethyl acetate, and methanol extracts derived from *A. gangetica* leaves. The study employed several experimental models, including guinea pig trachea, rat stomach strip, guinea pig ileal preparation, and egg albumin-induced acute inflammation. Results demonstrated that the extracts did not elicit contractile or relaxant effects in isolated tissue preparations. However, the extracts exhibited inhibitory activity against spasmogen-induced contractions [32].

Ageratum conyzoidesL.

A. conyzoides, an annual herbaceous plant of the *Asteraceae (Compositae)* family, is native to tropical America but has a widespread distribution across tropical and subtropical regions globally. In a study evaluating its pharmacological properties, the hydroalcoholic extract of A. conyzoides leaves demonstrated antihistaminic activity. This effect was observed through the inhibition of clonidine-induced catalepsy in a murine model, with the extract administered at doses of 250, 500, and 1000 mg/kg [33].

Amburana cearensis (Fabaceae)

Amburana cearensis (A. cearensis), a medicinal plant indigenous to the "caatinga" (savannah) region of Northeastern Brazil, is traditionally employed in the treatment of respiratory tract disorders, including asthma. Phytochemical investigation of A. cearensis trunk bark yielded the flavonoid iso-kaempferide. This compound demonstrated significant relaxant effects on guinea

pig tracheal smooth muscle, as evidenced by its ability to attenuate KCl-induced contractions[34].

Argemone Mexicana

Argemone mexicana (A. mexicana), a plant commonly found along roadsides and in fields throughout India, has demonstrated antiallergic and antistress properties. Aqueous extracts of *A. mexicana* stem, administered intraperitoneally at a dose of 50 mg/kg, showed efficacy in models of milk-induced leucocytosis and milk-induced eosinophilia[35].

Bacopa monnieri L. (Scrophulariaceae)

Bacopa monnieri L. (Scrophulariaceae) leaf extracts were evaluated for mast cell stabilizing activity in rats. Petroleum ether, chloroform, methanol, and water extracts, at doses of 10 µg/mL, significantly inhibited mast cell degranulation [36].

Brassica napus (Rapeseed)

Brassica napus (rapeseed), a yellow-flowered member of the *Brassicaceae* family, contains notable amounts of erucic acid. *Brassica napus L.* oil, at doses of 0.5 and 0.75 mg/kg, reduced lung eosinophil count and airway smooth muscle thickness in asthmatic rats[37].

Boswellia serrata (Frankincense)

Clinical studies on *Boswellia serrata (frankincense)* have shown promising results in asthma management. A randomized open-label comparative study reported decreased asthmatic attack episodes and improved forced vital capacity (FVC) and forced expiratory volume in one second (FEV1). In placebo-controlled double-blind studies, asthmatic patients treated with 300 mg gum resin thrice daily for six weeks showed improvements in various parameters, including

erythrocyte sedimentation rate, eosinophil count, peak expiratory flow rate, FVC, FEV1, and clinical symptoms [38].

Camellia sinensis (Tea)

Camellia sinensis (tea) leaf aqueous extract, at 25 µg/mL, exhibited anti-asthmatic activity by modulating cytokine expression. The extract increased TGF-β, IFN-γ, and IL-10 expression while decreasing IL-4, IL-13, and IgE levels in lung tissue[39].

Clerodendrum serratum Linn. (Verbenaceae)

Clerodendrum serratum, known as bharangi in Ayurvedic medicine, is traditionally used to treat various conditions [40]. The alcoholic extract of C. serratum root demonstrated anti-asthmatic effects in isolated goat tracheal chain preparation and anti-eosinophilia in mice at 50, 100, and 200 mg/kg concentrations [41]. Icosahydropicenic acid (100 mg/kg) isolated from *C. serratum* roots showed protective effects in experimental allergic asthma [42,43]. Aqueous and nonaqueous extracts exhibited anti-asthmatic effects in rats, with the extract reducing inflammation-inducing mediators in ovalbumin-induced asthma [44,45].

Biophytumsensitivum

The leaf alcoholic extract of *Biophytumsensitivum* at 100 and 200 mg/kg (p.o.) was studied for antiasthmatic effects in guinea pigs. The 200 mg/kg dose showed 67.5% protection compared to chlorpheniramine maleate (1 mg/kg, p.o.) at 76.6%. The extract exhibited significant anti-asthmatic effects by inhibiting histamine-induced broncho-constriction [46].

Momordica dioica

Momordica dioica, a climbing creeper, is traditionally used for various conditions. Methanol and aqueous extracts of the pulp demonstrated antihistaminic activity by inhibiting clonidine-induced catalepsy in mice at 50 mg/kg, possibly due to polar constituents [47].

Hemidesmus indicus R. Br. (Asclepiadaceae)

Ethanol extract of *Hemidesmus indicus* roots at 25, 50, and 100 mg/kg doses showed anti-asthmatic activity in isolated goat tracheal chain preparation, passive paw anaphylaxis in rats, and clonidine-induced catalepsy in mice [48].

Eclipta alba Linn (Asteraceae)

The 50% ethanol extract of *Eclipta alba* exhibited anti-anaphylactic and anti-histaminic activity at 250 and 500 mg/kg doses in various experimental models, including compound 48/80-induced mast cell degranulation and egg albumin-induced anaphylaxis [49].

Crinum glaucum (Amaryllidaceae)

Aqueous extract of *Crinum glaucum*, used in traditional Yoruba medicine, demonstrated antiallergic activity at 100-400 mg/kg doses. Effects included reduction in dye leakage area in passive cutaneous anaphylactic reaction, protection against mast cell degranulation, and inhibition of histamine-induced bronchoconstriction in guinea pigs [50].

Cassia sophera (Caesalpiniaceae)

Cassia sophera, traditionally used for asthma and bronchitis treatment, demonstrated significant anti-asthmatic activity through its chloroform, ethyl acetate, and ethanol fractions isolated from leaf ethanol extract. At doses of 250, 500, and 750 mg/kg, these fractions showed efficacy in various animal models, including carrageenan-induced paw edema, histamine-induced bronchoconstriction, and others. The activity may be attributed to the presence of flavonoids [51].

Anchomanesdifformis (Blume)

Anchomanesdifformis, used by herbal practitioners in Delta State, Nigeria, for asthma treatment, showed comparable anti-asthmatic activity to salbutamol in guinea pigs [52]. The aqueous leaf extract (400 mg/kg) demonstrated 32.7% efficacy, similar to salbutamol's 32.5%, verifying its asthma-relieving effect and safety [53].

Echinodorusscaber Rataj (Alismataceae)

The hydroethanolic leaf extract of *Echinodorusscaber*, a Brazilian native subaquatic herb, reduced inflammation in OVA-induced allergic asthma. At concentrations of 1, 5, and 30 mg/kg,

it decreased BALF IL-13, IL-5, IL-4, and IgE levels, comparable to dexamethasone (0.5 mg/kg) [54].

Ganoderma lucidum

Ganoderic acid C1 (GAC1) isolated from G. lucidum inhibited TNF-α production in asthma patients' peripheral blood mononuclear cells and murine macrophages stimulated by LPS. This effect was associated with NF-κB signaling pathway suppression and partial suppression of MAPK and AP1 pathways [55].

Ginkgo biloba

Ginkgo biloba extract showed various beneficial effects in asthma management [56]. Ginkgolide B (40 mg/kg) inhibited the ERK/MAPK signaling pathway, exerting an anti-inflammatory effect [57]. Clinical studies demonstrated reduced blood platelet-activating factor in asthmatic children, improved lung function in steroid-dependent patients, and decreased inflammatory cell infiltration in asthmatic airways when used as a complement to gluco-corticosteroid therapy 58,59].

Datura metel Linn.

Datura metel Linn., known by various common names, ameliorated asthma symptoms at a concentration of 0.56 mg/kg in Balb/c mice by reducing the number of activated T cells and maintaining T cells in naive-type status [60].

Descurainiasophia (Brassicaceae)

Descurainiasophia, a member of the Brassicaceae family, demonstrated beneficial effects in a rat model of allergic asthma. Pi et al. reported that this plant improved lung permeability in asthmatic rats through the modulation of epithelial damage and airway inflammation[61].

Table 1: List of Medicinal plants used as anti-asthmatic agents [62]

S. No.	Plant name	Plant parts used	Mechanism of action
1.	*Acanthus illicifolius*	Root	Anti-asthmatic, Anti-anaphylactic activity
2.	*Crinum jagus*	Root and bulb	Anti- asthmatic
3.	*S. xanthocarpum*	Herb	Bronchodilator
4.	*T. indica*	Whole plant	Bronchodilator, Membrane stabilizing
5.	*A. vasica*	Leaves	Bronchodilator, Anti-anaphylactic
6.	*Aconitum hetrophyllum*	Root	Cough, Asthma
7.	*Ricinus communis*	Leaves	Asthma, Cough
8.	*Saussurea ceratocarpa*	Whole plant	Bronchitis, Asthma
9.	*Solanum surratense*	Root, Berries, Fruit	Asthma, Cough
10.	*Thymus linearis*	Arial parts	Asthma, Cough
11.	*Trianthema portulacastrum*	Root	Asthma
12.	*Tylophora hirsuta*	Root, Leaves	Whooping cough and Asthma
13.	*Vitis vinifera*	Flower	Bronchitis

Echinacea angustifolia

Chicoric acid alkamides, a constituent of *E. angustifolia*, are commonly found in the western region of the country. It has long been used as a home remedy for whooping cough and bronchitis. It also has anti-asthmatic, gingivitis, and sinusitis properties. About 10 to 30 milliliters of syrup can be administered to an individual for acute disorders and serious chronic deficiencies, and 10 to 40 milliliters is recommended for chronic disorders and infection prophylaxis. You can also use dried herb tablets, which you can take three times a day[62].

Sphaeranthus indicus Kurz (Asteraceae)

A significant plant used in traditional medicine is *Sphaeranthus indicus*. Compared to the standard medication ketotifen, the ethanol extract at doses of 150 and 300 mg/kg and its ethyl acetate extract at doses of 100, 150, and 300 mg/kg demonstrated marginally better protection against sheep serum and Compound 48/80-induced mast cell degranulation[63].

Olea europea (Oleaceae)

Olea europea is a small, evergreen tree with grayish bark that grows to a height of 12 to 20 feet. Its branches are stiff and hoary. Ripe olive oil extract has anti-asthmatic properties by preventing

clonidine-induced peritoneal mast cell degranulation in rats and catalepsy in mice at dosages of 4 and 8 mg/kg. Additionally, at 100 µg/Ml, it shields against histamine-induced contraction of the goat trachea and guinea pig ileum[64].

Casuarina equisetifolia Linn (Casuarinaceae)

Evergreen *Casuarina equisetifolia* (*C. equisetifolia*) trees are grown along coastal regions from Gujarat to Orissa, as well as in certain areas of West Bengal and the Andaman Islands. They can reach heights of up to 50 meters. The methanol extract of wood and bark extracts has antihistaminic properties by preventing mast cell degranulation at doses of 100 mg/kg, clonidine-induced catalepsy, and histamine-induced contraction of the trachea (10-80 mcg/mL)[65].

Euphorbia hirta (Euphorbiaceae)

Euphorbia hirta, also referred to as asthma weed, is a herbaceous wild plant that grows in the hottest regions of India. By preventing the development of paw and passive cutaneous anaphylaxis reactions, as well as protecting mast cells from degranulation, an ethanol extract of the entire aerial part of the plant at doses of 100–1000 mg/kg exhibits antihistaminic and antiallergic activity[66].

Mucuna pruriens

At doses of 50, 100, and 200 mg/kg, the L-DOPA extracted from the methanol extract of seeds exhibits anti-histaminic activity by preventing mast cell degranulation and clonidine-induced catalepsy in mice[67].

Allium sativum (Garlic)

The species of garlic, *Allium sativum*, belongs to the Allium genus of onions. It is indigenous to northeastern Iran and Central Asia. El-Din et al. demonstrated the efficacy of Allium sativum in preventing the severe pathological abnormalities associated with rat asthma induced by lambda cyhalothrin. In albino rats, allium sativum at a dose of 100 mg/kg has been shown to relieve pesticide-induced bronchial blockage (no eosinophilic asthma), resulting in interstitial alveolitis and abscess formation [68]. It has been demonstrated that the sulfur compounds in garlic help asthma sufferers in a number of ways by regulating inflammation, antiviral cytokines, and other antioxidant, antiviral, and antibacterial processes. This treatment may be regarded as an

alternative or coadjuvant in the management of asthma since it delays the onset of the condition in this manner [69].

Camellia japonica

The family theaceae includes the *camellia japonica*. Its biological properties, including its ability to lower inflammation and oxidation, have been documented recently. In contrast to dexamethasone (10 mg/kg), Lee et al. showed that Camellia japonica oil at 100 and 500 mg/kg doses suppresses the occurrence of asthma via the GATA3 and IL-4 pathways. They found that in BALF, it lowers WBC, eosinophil count, and IgE. Additionally, it reduces inflammation cell infiltration, mucous hypersecretion, epithelial cell hyperplasia, IL-4, IL-5, IL-6, IL-13, and TNF-α in the lungs of asthmatic mice[70].

Cuscutaepithymum (Cuscuta chinensis Lam.)

The yellow, seemingly leafless, perennial grapevine *Cuscutaepithymum* is commonly found in tropical and temperate regions, such as China and India. Many species are used in the treatment of asthma. Methanol extract from C. chinensis seeds can lower asthmatic levels of IL-6, TNF-α, NF-κB, COX-2, and IL-1β[71].

Clerodendrum Serratum Linn (Verbenaceae)

Clerodendrum Serratum(C. serratum), also referred to in Ayurveda as "bharangi," has long been used as a remedy for rheumatism, respiratory conditions, malarial fever, pain, and inflammation. Using isolated goat tracheal chain preparation, the ethanol extract of C. serratum roots demonstrated antiasthmatic activity; clonidine induced catalepsy; milk induced leucocytosis and eosinophilia in mice at doses of 50, 100, and 200 mg/kg[72].

Ficus bengalensis Linn (Moraceae)

The enormous tree *Ficus bengalensisis*, rises to a height of around 30 m and sends out numerous aerial roots from its branches. At a dose of 50 mg/kg, ethanol, ethyl acetate, and aqueous extracts, along with fractions extracted from the aqueous extract of F. bengalensis bark, exhibit antihistaminic activity by preventing clonidine-induced catalepsy in mice. The existence of flavonoids may be the cause of these actions[73].

CurculigoorchioidesGaertn (Amaryllidaceae)

A small herbaceous plant called *Curculigoorchioides (C. orchioides)* is widely found in China, Malaya, Japan, and India.At doses (100–400 mg/kg), an alcoholic extract of *C. orchioides* rhizomes exhibits antihistaminic and mast cell stabilizing activity on Compound 48/80-induced mast cell degranulation and systemic anaphylaxis [74]. Additionally, it prevented the contraction of the goat trachea, the ileum of guinea pigs, and the bronchoconstriction of guinea pigs caused by histamine; rats experienced passive paw anaphylaxis due to egg albumin; mice experienced catalepsy due to clonidine [75].

Piper betel Linn

In the past, *piper betel* was used to treat rheumatism, asthma, pruritis, cough, and cold. At doses of 100 and 200 mg/kg, ethanol and an aqueous leaf extract exhibit anti-asthmatic activity against histamine-induced broncho-constriction in guinea pigs, as well as against histamine-induced dose-dependent contraction of the tracheal chain and isolated guinea pig ileum preparation [76].

Crataegus pinnatifida (Mountain Hawthorn)

In comparison with montelukast (30 mg/kg), the administration of *Crataegus pinnatifida* ethanolic extract at concentrations of 100 and 200 mg/kg in the murine asthma model significantly reduces inflammatory cells, especially eosinophils in the lung tissue and BALF. It also decreases AHR, OVA-specific IgG levels, OVA-specific IgE, and total IgE in the serum, as well as eotaxin, IL-13, IL-5, and IL-4 after OVA challenge in BALF. According to these results, ethanolic Crataegus pinnatifida extract may be useful in preventing allergic asthmatic airway inflammation from developing. Furthermore, downregulating MMP-9 results in a decrease in the expression of VCAM-1 and ICAM-1, which is one way that the alcoholic extract of Crataegus pinnatifida partially reduces inflammation [77].

Curcuma longa Rhizome (Turmeric)

Curcuma longa, or turmeric, is a bright yellow chemical that is produced by plants that belong to the *Zingiberaceae*family, which also includes ginger. When compared to dexamethasone (2 mg/kg), curcumin at 50, 100, and 200 mg/kg effectively suppressed IL-17A, enhanced IL-10, and prevented eosinophil recruitment and mucus overproduction in mice with OVA-induced asthma. In OVA-sensitized mice, curcumin reduced allergic airway inflammation by controlling the balance between CD4+ CD25+ Tregs and Th-17 [78]. Following an eight-week course of treatment with 200 mg/kg of curcumin, lesions in the aortic root were found to significantly improve, and the elevated Th-17 and Th-2 cells were found to significantly decreased[79].

Adiantum capillus-veneris L. (Fern)

The ferns in the genus *Adiantum* and family *Pteridaceae*, which include the Venus hair fern, maidenhair fern, black maidenhair fern, and southern maidenhair fern, are found in sub-cosmopolitan regions across the globe. Asthma is among the respiratory conditions for which this plant generally has been shown to be ameliorative [80].

Asystasiagangetica T. Adams (Acanthaceae)

Many regions of Nigeria employ *A. gangetica*in the treatment of asthma. Using guinea pig trachea, rat stomach strips, guinea pig ileal preparation, and egg albumin-induced acute inflammation, *Akah et al.* assessed the anti-asthmatic activity of hexane, ethylacetate, and methanol extracts from the leaves of *A. gangetica*. The findings revealed that while the extracts did not show any contractile or relaxing activity in isolated tissue preparations, they did prevent spasmogen-induced contractions [81].

Descurainiasophia

Descurainiasophia belongs to the *Brassicaceae* family. *Pi et al.* demonstrated that in rats with allergic asthma, descurainiasophia improves lung permeability by controlling epithelial damage and airway inflammation [82].

Conclusion

This review underscores the potential of herbal formulations in the management of respiratory diseases, particularly asthma. Traditional herbal treatments have shown promising results when compared to conventional pharmaceutical interventions. The plants discussed herein demonstrate

anti-asthmatic, antibacterial, and antioxidant properties, which may contribute to more comprehensive management of respiratory tract symptoms.

The analysis focuses on several key species, including *Anogeissus acuminata, Crinum,Piper betel Linn, Curcuma longa Rhizome, Descurainiasophia,Gingko biloba*, all of which have shown promise in disease management and exhibit antimicrobial properties.The therapeutic potential of these plants stems from their diverse bioactive compounds, with some species demonstrating multiple mechanisms of action. It is noteworthy that different plant parts may contain distinct biomolecules, each contributing to the plant's overall medicinal value. Many of these plants contain essential oils and have demonstrated a range of beneficial properties, including antioxidant, anti-inflammatory, antibacterial, and antispasmodic effects. Some have also shown potential as anti-anaphylactic agents and bronchodilators.Furthermore, certain plants in this review have been found to support nerve function, while others specifically nourish the lungs and airways. The cumulative evidence suggests that these botanical agents can effectively combat asthma symptoms while concurrently exerting antimicrobial effects.

List of Abbreviations

Declarations

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