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A Review On Medicinal Plants With Anti-Asthmatic Potential

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Abstract:
Asthma is a chronic disease that is rising worldwide with the highest prevalence in industrialized countries. Asthma affects about 300 million people worldwide and it has been estimated that a further 100 million will be affected by 2025. Since the ancient times, plants have been ideal sources of medicine. Current asthma therapy fails due to adverse effects; hence patients are seeking complementary and alternative medicine to treat their asthma/disease. Ayurveda and other ancient Indian literature speak briefly the use of plants in various human ailments. Studies conducted in the last few decades on the plants mentioned in ancient literature or used traditionally for asthma have shown antiasthmatic, antihistaminic and antiallergic activity. This review reveals that some plants and their extract have antiasthmatic activity.
Keywords: *Asthma, Medicinal Plants, Pathophysiology, In-vitro, In-vivo.*

INTRODUCTION

1.3 Asthma

Asthma is a chronic inflammatory disorder of the airways associated with increased hyper-responsiveness, recurrent episodes of wheezing, breathlessness, chest tightness, and coughing because of reversible bronchoconstriction resulting from increased responsiveness of tracheobronchial tree to various stimuli.[1] This causes inflammation of the airway wall by increased number of inflammatory cells, most notably eosinophils, basophils, mast cells, macrophages, and certain types of lymphocytes [2,4]. Asthma could be extrinsic and intrinsic depending upon the type of stimuli that triggers the attack.

✓ Extrinsic asthma is caused by a type of immune system response to inhaled allergens such as pollen, animal dander or dust mite particles.[3]

✓ Intrinsic asthma is caused by inhalation of chemicals such as cigarette smoke or cleaning agents, taking aspirin, chest infection, stress, cold air, exercise, food preservatives or a myriad of other factors [5].

1.4 Epidemiology of asthma: an Overview

Asthma is world's most common long term disease conditions. According to the World Health Organization (WHO) over 339 million people around the world suffer from asthma, every day about 1,150 people die due to asthma as reported in 2018 [6]. In India, an estimated 57,000 deaths were attributed to Asthma in 2004 and it was seen as one of the leading cause of morbidity and mortality in India [7, 8, 9].

Though effective screening, evaluation and management strategies for asthma are well established in high income countries, these strategies have not been fully implemented in India [10, 11]. Even though the medicines to treat asthma are available at affordable costs it benefits less than a percent [12].

1.5 Asthma-Global impact

Asthma is a non-reportable disease. Therefore, its global prevalence is difficult to determine since differences exist in regards to diagnostic protocols and access to healthcare. Furthermore, many asthma patients may be undiagnosed, as a recent study from Russia demonstrated that 6.9% of adults answering a questionnaire reported an asthma diagnosis, but 25.7% of the same population reported symptoms of asthma. According to Croisant's epidemiology section in the textbook Heterogeneity in Asthma published in 2014, approximately 4.3% of the world's population (300 million people) suffer from asthma. A recent study from Italy has confirmed that asthma is on the rise in countries outside of the United States, as a hike in asthma prevalence in Italy from 3.4 to 7.2% approximately in a period of 25 years. The Global Initiative for Asthma estimates that there will be an additional 100 million people with asthma around 2025 [13].

1.6 Prevalence of asthma

The prevalence of asthma has been estimated to range 3-38% in children and 2-12% in adults, being the commonest chronic disorder among children. In India, a recent Study on Epidemiology of Asthma, Respiratory Symptoms and Chronic Bronchitis (INSEARCH) done with 85,105 men and 84,470 women from 12 urban and 11 rural sites estimated the prevalence of asthma in India to be 2.05% among those aged >15 years, with an estimated National burden of 18 million asthmatics [14] .

1.7 Initiator components of allergic asthma

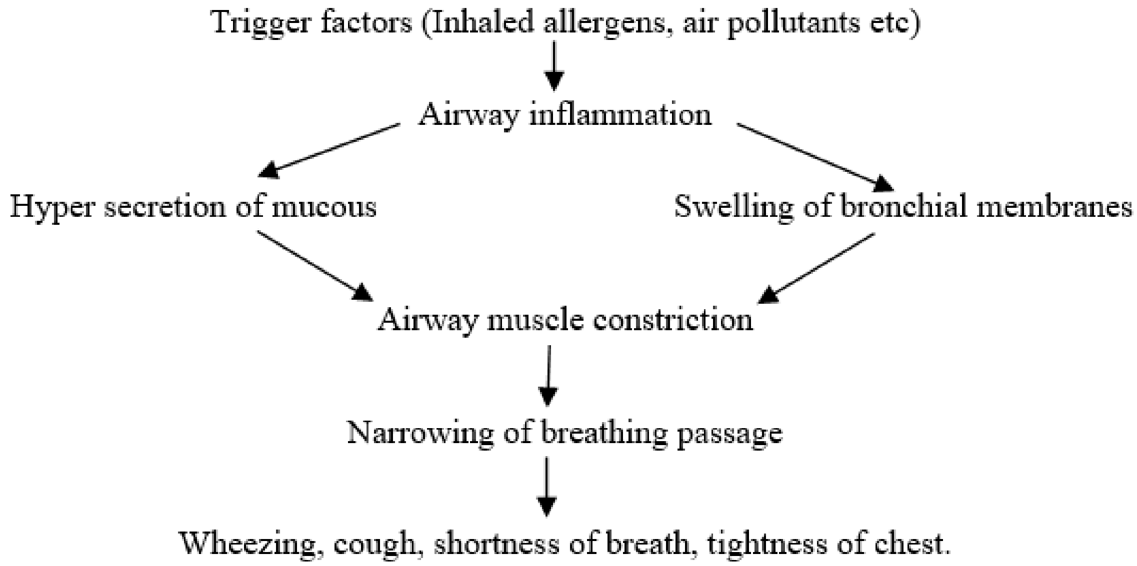
Allergy is an important undesirable side effect of immunity, which develops under certain conditions of hypersensitivity. Low molecular weight chemicals cause allergy by getting combined with an endogenous protein to form an antigenic complex. Based on the mechanism of immunological involvement there are 4 categories of allergic responses. Type I allergic reaction is the immediate hypersensitivity reaction. The allergen, immunoglobulin E (IgE) antibody, mast cell and its mediators (performed and newly released) are the major components of this type of allergic reaction.

An allergen binds to the Fab portion of the IgE antibody and the Fc portion binds to the mast cell receptor and basophils, which further leads to defragmentation of the mast cell and thus releasing the performed mediators such as histamine, leukotrienes and prostaglandins.

The newly formed mediators such as leukotrienes, prostaglandins, prostacyclin, lipoxins, thromboxanes are also responsible for the degranulation of the mast cells [4]. The intial activation of the allergic reaction is responsible for the initial signs and symptoms in the respiratory system such as wheezing, running nose, edema etc, and the signs of the later stages are the airway remodelling and hyperplasia of the nasal tract etc. Anaphylaxis, allergic asthma, allergic rhinitis, allergic conjunctivitis and urticaria are some examples of Type I allergic diseases [15].Type II is antibody dependent cytotoxic reaction, haemolytic transfusion reaction and haemolytic disease of newborns are examples of this type. Type III is immune complex reaction, serum sickness and rheumatoid arthritis are examples of type III reaction. Type IV is cell mediated (delayed hypersensitivity) reaction. Tuberculin reactions, chronic asthma and contact dermatitis are examples of type IV allergic reaction.

1.8 Pathophysiology and therapeutic targets of asthma

Allergic asthma is a complex disease that is characterized by reversible airway obstruction, increased serum IgE level, airway remodelling, chronic eosinophilic airway inflammation, hypersecretion of mucus, airway hyperresponsiveness to bronchospasmogenic stimuli. These characteristic symptoms of asthma are mediated by many inflammatory cellular factors such as mast cells, eosinophils, neutrophils, macrophages and dendritic cells and also several other inflammatory mediators. Development of specific mediator-receptor antagonists or inhibitor of mediator synthesis may give the novel therapeutic regimen to counter asthma [16]. Some important cells/molecules that contribute to the pathogenesis of asthma are



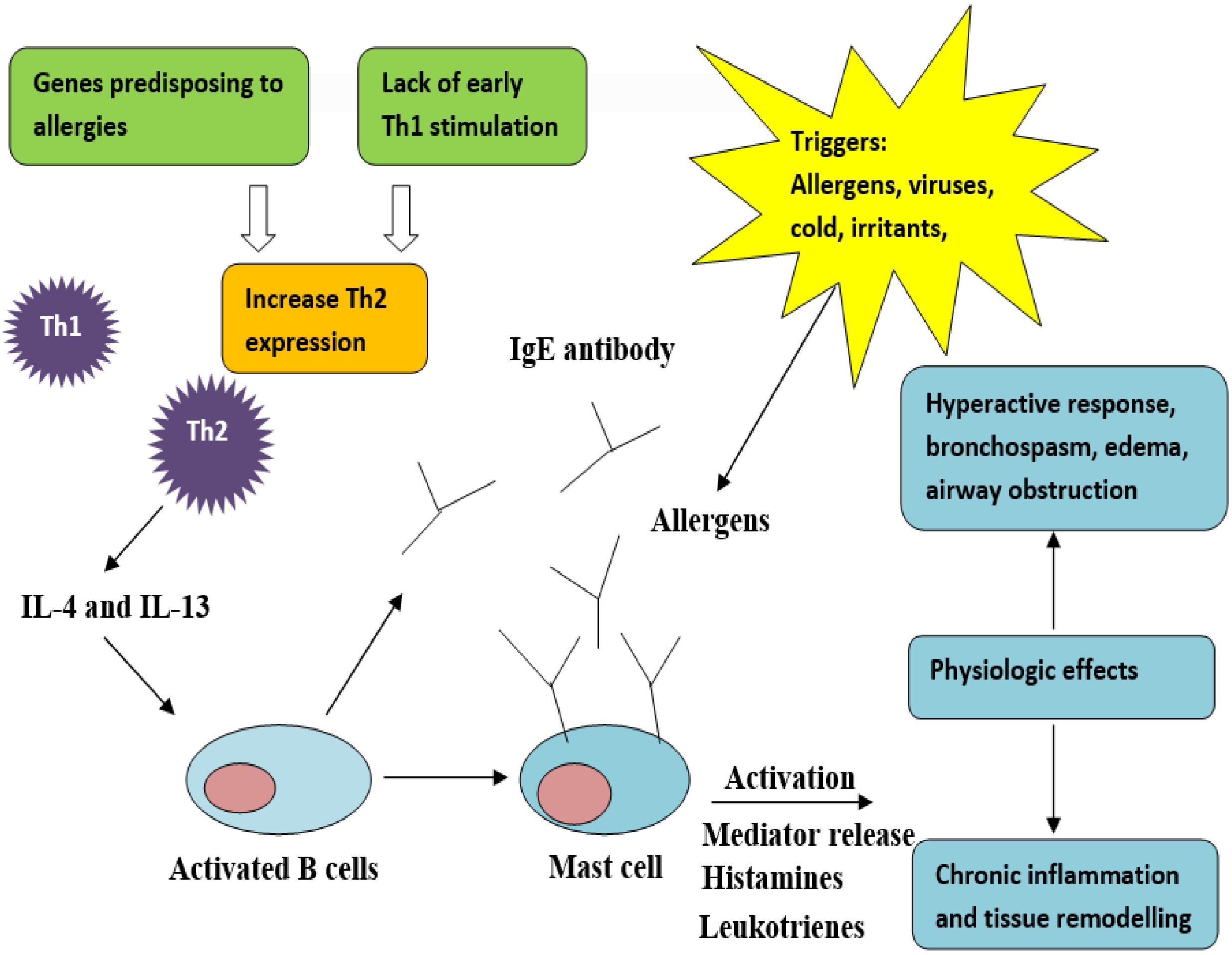


Figure1:Pathogenesis of Asthma

RESULT:

Table 1: Medicinal plants with anti-asthmatic effect

S.No	Plant material	Family	Parts	Invitro studies	Invivo studies	Ref
1	*Acorus calamus*	Acoraceae	Leaves Roots Rhizomes	Histamine induced contractile response in isolated guinea pig ileum Histamine induced bromchospasm in guinea pig isolated Guinea pig ileum preparation	No Data Histamine Aerosol induced bronchoconstriction in Guinea pigs	17 18 19
2	*Aerva lanta*	Amaranthaceae	Whole plant Aerial parts	Not performed Isolated goat tracheal chain preparation model	Ovalbumin induced allergic asthmatic mice Clonidine-induced catalepsy and Mast cell degranulation in mice	20 21
3	*Ailanthus excels*	Simaroubaceae	Stem bark	Isolated Guinea pig ileum preparation	Histamine induced bronchoconstriction in Guinea pigs	22

			Leaves	Isolated goat trachea chain preparation	Clonidine induced catalepsy in mice and Clonidine-induced mast cell degranulation	23
4	*Alternanthera sessilis*	Amaranthaceae	Stem	Not performed	Guinea pigs model	24
5	*Azima tetracantha*	Salvadoraceae	Leaves	Mast cell stabilization assay	No Data	25
6	*Bacopa monnieri*	Plantaginaceae	Leaves and stem	Not performed	OVA-induced airway inflammation in BALB/C mice.	26
7	*Boerhaavia diffusa*	Nyctaginaceae	Roots	Isolated Goat tracheal chain preparation	Histamine induced Bronchoconstriction in Guinea pig	27
8	*Calotropis gigantean*	Apocynaceae	Flowers Leaves Roots	No Data No Data Isolated Guinea pig ileum preparation	Histamine and acetylcholine induced Bronchoconstriction in Guinea pig Histamine induced Bronchospasm in Guinea pig Acetylcholine and Histamine induced bronchospasm in guinea pigs, Haloperidol induced catalepsy and passive paw anaphylaxis in rats	28 29 30
9	*Calotropis procera*	Asclepiadaceae	Root Leaves	isolated guinea pig ileum preparation Not performed	guinea pig tracheal chain Chlorine induced asthma in Albino mice	31 32
10	*Clerodendron phlomidis*	Lamiaceae	Leaves	Isolated goat tracheal chain	Milk- induced eosinophilia, mast cell degranulation and capillary permeability in mice.	33
11	*Cynodon dactylon*	Poaceae	Leaves	isolated guinea pig ileum preparation and isolated guinea pig tracheal chain preparation	Histamine and acetylcholine induced bronchospasm in guinea pigs and milk induced eosinophilia in mice model	34
12	*Eclipta prostrata*	Asteraceae	Whole plant	Not performed	murine model of asthma	35
13	*Elaeagnus pungens*	Elaeagnaceae	Leaves	Not performed	Histamine and acetylcholine induced Bronchoconstriction in Guinea pig	36
14	*Hemidesmus indicus*	Asclepiadaceae	Roots	Not performed	Isolated goat trachea chain preparation Clonidine induced catalepsy in mice	37
15	*Ipomoea aquatic*	Convolvulaceae	Leaves	Not performed	OVA induced murine model.	38
16	*Justicia procumbens*		Aerial parts	Not performed	Spleen Cell Culture and Cytokine Assay OVA induced murine model.	39
17	*Mangifera indica*	Anacardiaceae	Bark	Not performed	Airway inflammation and Th2 cytokines in murine model	40
18	*Ocimum basilicum*	Lamiaceae	Leaves Seeds	Not performed Not performed	Ovalbumin-induced rat model Ovalbumin-induced rat model	41 42

19	Pothos scandens	Araceae	Aerial parts	-	Mast cell stabilization	43
20	*Vitex negunda*	Lamiaceae	Leaves	Not performed	Murine model of OVA-LPS induced allergic asthma	44
			Leaves	Not performed	Heterologous passive cutaneous anaphylaxis model and Egg-albumin induced asthma in guinea pigs	45

DISCUSSION:

Asthma, a chronic respiratory condition characterized by airway inflammation and bronchoconstriction, significantly impacts the quality of life of millions worldwide. Despite the availability of conventional treatments, there is a growing interest in alternative therapies, particularly the use of medicinal plants known for their antiasthmatic properties.

Acorus calamus, commonly known as sweet flag, has been traditionally used for its anti-inflammatory and bronchodilatory effects. The rhizomes contain bioactive compounds such as α-asarone and β-asarone, which exhibit significant antispasmodic and anti-asthmatic properties. Studies have shown that these compounds can reduce bronchial constriction and inflammation, thereby improving airflow and reducing asthma symptoms.[17,19]

The leaves and bark of *Ailanthus excelsa* possess anti-inflammatory and bronchodilatory properties. The presence of quassinoids and alkaloids contributes to its efficacy in treating asthma. These compounds have been demonstrated to inhibit the release of histamine and other inflammatory mediators, which are pivotal in the pathophysiology of asthma. *Azima tetracantha*, known for its anti-inflammatory and immunomodulatory properties, contains bioactive compounds such as lignans and flavonoids. These compounds help in reducing airway inflammation and modulating immune responses, which are crucial in controlling asthma exacerbations.[22] *Boerhaavia diffusa* has a long history of use in Ayurvedic medicine for respiratory ailments. Its anti-asthmatic activity is attributed to its bronchodilatory, anti-inflammatory, and immunomodulatory effects. The plant contains bioactive compounds like boeravinones and punarnavoside, which help in reducing bronchial inflammation and improving lung function. The latex and leaves of *Calotropis gigantea* are rich in compounds such as calotropin and uscharin, which have shown significant bronchodilatory and anti-inflammatory effects. These compounds help in relaxing the bronchial muscles and reducing airway inflammation, thereby alleviating asthma symptoms.[26] *Clerodendron phlomidis* possesses anti-inflammatory and bronchodilatory properties, making it a valuable medicinal plant in asthma management. The plant contains diterpenes and flavonoids, which help in reducing bronchial hyperresponsiveness and airway inflammation. *Elaeagnus pungens* aid in reducing bronchial inflammation and spasms, thereby improving respiratory function in asthma patients.[28] *Ipomoea aquatica*, commonly known as water spinach, has been traditionally used for its anti-inflammatory and bronchodilatory effects. The plant contains bioactive compounds such as alkaloids and flavonoids, which help in reducing airway inflammation and bronchoconstriction.[29] The presence of lignans and flavonoids in *Justicia procumbens* contributes to its effectiveness in reducing airway inflammation and improving respiratory function in asthma patients.[30] *Mangifera indica*, commonly known as mango, has leaves and bark that exhibit significant anti-inflammatory and bronchodilatory properties. The presence of mangiferin and other polyphenols helps in reducing bronchial inflammation and improving lung function. *Pothos scandens*, known for its anti-inflammatory and bronchodilatory properties, contains bioactive compounds such as flavonoids and saponins. These compounds help in reducing airway inflammation and bronchoconstriction, thereby improving respiratory function in asthma patients.

The use of medicinal plants in the management of asthma offers a promising alternative or complementary therapy to conventional treatments. The antiasthmatic activity of these plants is primarily due to their anti-inflammatory, bronchodilatory, and immunomodulatory properties. Further research and clinical trials are essential to validate the efficacy and safety of these medicinal plants, ensuring their integration into mainstream asthma management protocols. These medicinal plants highlights the importance of exploring natural remedies in the quest for effective asthma treatments.

CONCLUSION:

The integration of these medicinal plants into asthma management strategies offers a complementary approach to conventional therapies, potentially enhancing treatment efficacy and reducing side effects. However, it is crucial to acknowledge the need for rigorous clinical trials to establish standardized dosages, safety profiles, and long-term efficacy of these herbal treatments. While the initial findings are encouraging, healthcare professionals should guide the use of these medicinal plants to prevent adverse interactions with conventional asthma medications. Future research should focus on exploring the synergistic effects of these plants with standard treatments, understanding their molecular mechanisms in greater detail, and developing optimized formulations for clinical use. In conclusion, medicinal plants hold a valuable place in the arsenal against asthma, providing hope for more holistic and effective management of this chronic respiratory condition. Their incorporation into mainstream medical practice could revolutionize asthma care, but it must be approached with caution, scientific rigor, and an emphasis on patient safety.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation.

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