



ANTI-ASTHMATIC ACTIVITY OF MEDICINAL AND AROMATIC PLANTS: A REVIEW BASED ON THE TRADITIONAL SYSTEMS OF MEDICINE IN INDIA

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ABSTRACT

Indian traditional system of medicine i.e Ayurveda and folklore system described thousands of medicinal and aromatic plants for the treatment of various diseases and ailments. Most of the medicinal plants are available as wild source and they are not explored scientifically for the utilization of mankind. Hence, there is a need to evaluate the biological activity of huge number of medicinal plants by using modern high throughput screening techniques. As we know, asthma is a very serious problem worldwide both in developed and developing countries. A few number of allopathic drugs available in the market for the treatment of asthma but they are unsafe for long term use. Hence the requirement of anti-asthmatic drugs getting popular day to day. At the same time the utilization of herbal medicine in the treatment of various diseases is also increasing globally. Since the ancient times, numbers of medicinal and aromatic plants are being used as anti-asthmatic drugs with effective biological response and with less or no toxic effects. By considering the public interest and importance of herbal drugs, it is necessary to search for the development of herbal medicine in the treatment of asthma. In the present review various medicinal and aromatic plants from Ayurveda and folklore system of medicine, which possess anti-asthmatic properties are gathered and listed for the convenience.

KEYWORDS: Asthma, Anti-Asthmatic Activity, Herbal Drugs.

INTRODUCTION

Asthma is a chronic inflammatory disease of the lungs, which is characterized by broncho constriction associated with infiltration of immune cells, mucus hypersecretion and structural remodeling of the airways.^[1] Chronic inflammation and structural changes are responsible for asthma. Depending upon severity and characters, it is classified as intermittent asthma, mild persistent asthma, moderate persistent asthma and severe persistent asthma. And factors that are caused to precipitate asthma are allergies, environmental factors, smoking, obesity, heredity, stress and hyper reactivity.

Allergens from nature, typically inhaled, which include waste from common household pests, the house dust mite and cockroach, as well as grass pollen, mold spores, and pet epithelial cells.^[2] During an asthma episode, inflamed airways react to environmental triggers such as smoke, dust, or pollen. The airways narrow and produce excess mucus, making it difficult to breathe. In essence, asthma is the result of an immune response in the bronchial airways.^[3] In 1968 Andor Szentivanyi first described The Beta Adrenergic Theory of Asthma; in

which blockage of the Beta-2 receptors of pulmonary smooth muscle cells causes asthma.^[4] Szentivanyi's Beta Adrenergic Theory is a citation classic^[5] using the Science Citation Index and has been cited more times than any other article in the history of the Journal of Allergy and Clinical Immunology. In 1995 Szentivanyi and colleagues demonstrated that IgE blocks beta-2 receptors.^[6] Since overproduction of IgE is central to all atopic diseases, this was a watershed moment in the world of allergies.^[7] Asthma is associated with a procoagulant state in the bronchoalveolar space.^[8] The airways of asthma patients are "hypersensitive" to certain triggers, also known as stimuli. (It is usually classified as type I hypersensitivity.)^[9&10] Asthma affects four to eight out of a hundred pregnant women.^[11] This is due to the fact that during pregnancy, there is an immunological shift due to hormonal fluctuations.^[12] In some cases, there is an increase in Estrogen levels which in turn reduce the activity of natural killer cells, Th1 cell production of inflammatory cytokines, and production of anti-inflammatory cytokines.^[12] As we have seen, these play an important role in the pathophysiology of asthma.

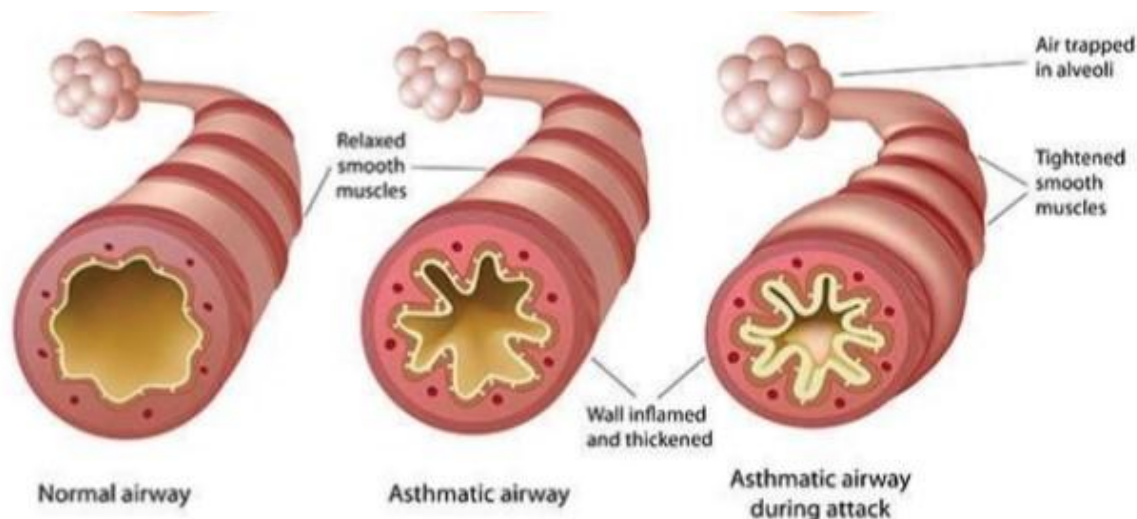


Figure: Pathophysiology of asthma

There are 300 million asthmatics worldwide with 1/10 of those living in India. As per the WHO most asthma related deaths occur in low and lower middle income countries. According to the latest WHO estimates, released in December 2016, there were 3,83,000 deaths due to asthma in 2015.^[13]

The newer drugs developed from plant sources are renewable and may provide therapeutic efficacy without undesirable toxic effects besides being cheap and providing lead molecules for synthetic analogues. There are many unexplored plant species which may be useful as a source for new chemical entities with potent biological activities and also as unique templates that could serve as starting materials for the design of new synthetic chemical entities with improved properties.

Recent evidence suggests that leukotriene inhibitors may have an important role in the treatment of Asthma^[14 & 15]. Leukotriene inhibitors are grouped into three: 5-Lipoxygenase inhibitors^[16&17], FLAP (activating protein) inhibitors and Cys-Lt1 receptors antagonists.^[18] Currently Zileuton, a selective 5-Lipoxygenase inhibitor,^[19&20] and Montelukast, a leukotriene C4 receptor antagonist^[21] are in the market for the treatment of asthmatic disorders. But it has been observed that the use of Zileuton has adverse side effects such as elevation of liver enzymes and jaundice—one in 5000 patients. On the other hand, nor-dihydro guaretic acid (NDGA) a natural product from plant has shown promising results as selective 5-lipoxygenase inhibitors with minimal side

effects. This finding helped researchers to take up efforts to identify natural products for asthma treatment. The drug like Zileuton (5-LOX inhibitor), montelukast and zafirlukast (Leukotriene C4/D4 receptor antagonists) are presently available in the market for treatment of asthma. However, these are associated with many side effects and as a result the search is on for more effective and safer drugs for asthmatic disorders.

A number of medicinal plants are being used in the traditional system of knowledge for the treatment of asthma and other respiratory disorders. Some of these include: plants of Zingiberaceae, *Myrica esculenta*, *Nyctanthes*, *Boswellia serrata*, *Phyllanthus urinaria*, *Aerva lantana* Linn, *Argemone Mexicana*, *Bacopa monnaria*, *Cassia sophera*, *Eclipta alba*, *Euphorbia hirta*, *Ficus bengalensis*, *hemidesmus indicus* etc, in the present review some of these locally available will be exploited for evaluation of anti-asthmatic properties.

Medicinal Plants Used in the Treatment Of asthma^[22]

Our traditional system of medicine Ayurveda and folk medicine system of medicine is familiar worldwide. From this source we have identified and mentioned a huge number of medicinal and aromatic plants with anti-asthmatic properties in this review. We assure that the identification and development of bioactive compounds from these plants is very useful in the treatment of asthma. Some of the medicinal and aromatic plants with anti-asthmatic activity listed below for further research.

Table. Medicinal and Aromatic Plants With Anti-Asthmatic Activity.

S. No	Name of the Plant	Family	Part Used	Evaluated Activity of the Plant
1	<i>Abutilon crispum</i> (L.) medicus	Malvaceae	Leaves	Hepatoprotective ^[23]
2	<i>Abutilon indicum</i> (L.) sweet	Malvaceae	Seed	Hypoglycemic ^[24] , Anti-arthritis ^[25] , Anti-diabetic ^[26]
3	<i>Acacia tortu</i> roxb	Mimosaceae	Bark	Anti-arthritis ^[27]
4	<i>Acalypha hispida</i>	Euphorbiaceae	Flower	Trypanocidal effect ^[28]
5	<i>Acalypha indica</i>	Euphorbiaceae	Leaves	Anti-inflammatory ^[29] , Anti-diabetic ^[30]
6	<i>Achyranthus aspera</i> Linn	Amaranthaceae	Whole plant	-----
7	<i>Aerva lanta</i> Linn	Amaranthaceae	Aerial parts	Anticancer ^[31]
8	<i>Alstonia scholaris</i>	Apocyanaceae	Bark	Ant malarial ^[32] , Anti-diabetic and Anti-hyperlipidemic ^[33]
9	<i>Andrographis paniculata</i>	Acanthaceae	Whole plant	Anti-inflammatory ^[34] , Anti-viral and Immunostimulant ^[35]
10	<i>Anesomeles squamosa</i>	Lamiaceae	Root	-----
11	<i>Anthocephalus chinensis</i>	Rubiaceae	Bark	-----
12	<i>Aster amellus</i>	Asteraceae	Root	-----
13	<i>Azadirachta indica</i>	Meliaceae	Bark	Antiproliferative ^[36]
14	<i>Azima tetracantha</i>	Meliaceae	Leaf	Anti-microbial ^[37]
15	<i>Barleria buxifolia</i>	Acanthaceae	Leaves	Anthelmintic ^[38]
16	<i>Barleria courtallia</i>	Acanthaceae	Leaves	Anti-inflammatory ^[39]
17	<i>Barleria cristata</i>	Acanthaceae	Leaves & Roots	Anti-inflammatory ^[40] , Anti-diabetic ^[41]
18	<i>Barleria longifolia</i>	Acanthaceae	Leaves & Roots	Antibacterial ^[42]
19	<i>Barleria strigosa</i>	Acanthaceae	Leaves & Roots	Cytotoxicity and antimicrobial ^[43]
20	<i>Biophytum nervifolium</i>	Oxalidaceae	Leaves	Anti-tumor activity ^[44]
21	<i>Biophytum sensitivum</i>	Oxalidaceae	Leaves	Hypoglycemic ^[45]
22	<i>Boerhaavia diffusa</i>	Nyctaginaceae	Whole plant	Hepatoprotective ^[46] , Anti-Convulsant ^[47]
23	<i>Bridelia stipularis</i>	Euphorbiaceae	Bark	-----
24	<i>Caesalpinia bonduca</i>	Caesalpiniaceae	Seeds	Antitumor ^[48] , Antipyretic ^[49]
25	<i>Caesalpinia pulcherrima</i>	Caesalpiniaceae	Leaves	Cytotoxic ^[50]
26	<i>Calamus rotang</i>	Arecaceae	Whole plant	CNS depressant, analgesic and anti-inflammatory ^[51]
27	<i>Calotropis gigantea</i>	Asclepiadaceae	Flower	Anthelmintic ^[52]
28	<i>Calotropis procera</i>	Asclepiadaceae	Flower	Anti-inflammatory ^[53]
29	<i>Cardiospermum halicabum</i>	Sapindaceae	Root	Antiviral ^[54]
30	<i>Careya arborea</i>	Burseraceae	Bark	Anti ulcer ^[55]
31	<i>Cassia occidentalis</i>	Caesalpiniaceae	All parts	Hepatoprotective ^[56]
32	<i>Cassia sophera</i>	Caesalpiniaceae	All parts	Hepatoprotective ^[57]
33	<i>Cassia abusa</i>	Caesalpiniaceae	Seeds	-----
34	<i>Casuarina equisetifolia</i>	Casuarinaceae	Bark	Spasmolytic ^[58]
35	<i>Centella asiatica</i>	Umbelliferae	Whole plant	wound healing ^[59]
36	<i>Cissampelos pareira</i>	Menispermaceae	Root	Antiinflammation ^[60] , Antinociceptive ^[61]
37	<i>Cissus quadrangularis</i>	Vitaceae	Whole plant	Analgesic, anti-inflammatory ^[62]
38	<i>Citrullus colocynthis</i> (L.)	Cucurbitaceae	Root	Analgesic and Antiinflammation ^[63]
39	<i>Clerodendrum indicum</i>	Verbinaceae	Root	Hepatoprotective ^[64]
40	<i>Cleodendrum philippinicum</i>	Verbinaceae	Root	Antidiabetic ^[65]
41	<i>Clitoria ternata</i>	Fabaceae	Root	----
42	<i>Coccinia indica</i>	Cucurbitaceae	Leaf, seed, root	Anti-inflammatory, analgesic and antipyretic ^[66] , Hypoglycemic ^[67]
43	<i>Cocculus hirsutus</i> (L.)	Menispermaceae	Leaf, root	Antihyperglycemic ^[68]
44	<i>Cochlospermum religiosum</i>	Cochlospermaceae	Seed	----
45	<i>Costus speciosus</i>	Zingiberaceae	Rhizome	Antidiabetic ^[69]
46	<i>Curculigo orchioides</i>	Hypoxidaceae	Tubers	Immunostimulant ^[70]
47	<i>Curcuma amada</i>	Zingiberaceae	Rhizome	Antiinflammation ^[71]
48	<i>Datura metel</i>	Solanaceae	Leaf, fruit, seed	Hypoglycemic and Antihyperglycemic ^[72] , Hallucinogenic ^[73]
49	<i>Datura stramonium</i>	Solanaceae	Leaf, fruit, seed	-----

50	<i>Dendrophthae falcate</i>	Loranthaceae	Shoots	Wound healing and Antimicrobial ^[74]
51	<i>Desmodium gangeticum</i>	Fabaceae	Root	Hepatoprotective ^[75]
52	<i>Dicranopties linearis</i>	Gliecheniaceae	Rhizome	Antinociceptive and Anti-inflammatory ^[76] , Gastroprotective ^[77]
53	<i>Drimia indica</i>	Liliaceae	Bulb	Anthelmintic and antimicrobial ^[78]
54	<i>Echinops rchinotus</i>	Asteraceae	Whole plant	Antiinflammation ^[79]
55	<i>Elytraria acaulis</i>	Acanthaceae	Herb	Antidiarrhoeal ^[80] , Anti Hyperglycemic ^[81]
56	<i>Embelia ribes</i>	Myrsinaceae	Roots	Wound healing ^[82] , Neuroprotective ^[83]
57	<i>Embelia tesjerium</i>	Myrsinaceae	Root	Anti-Inflammatory ^[84]
58	<i>Erythrina indica</i>	Fabaceae	Bark	Antihyperlipidemic ^[85]
59	<i>Erythrina stricta Roxb</i>	Fabaceae	Stem bark, flower	Anti-Inflammatory ^[86] , Anticataract ^[87]
60	<i>Erythrina variegata</i>	Fabaceae	Bark	Antibacterial ^[88] , Antibacterial ^[89]
61	<i>Eucalyptus globules</i>	Myrtaceae	Leaves	Antibacterial ^[90]
62	<i>Eulophia nuda</i>	Orchidaceae	Tuber	Cytotoxic ^[91]
63	<i>Euphorbia hirta</i>	Euphorbiaceae	Whole plant	-----
64	<i>Euphorbia tirucalli</i>	Euphorbiaceae	Whole plant	-----
65	<i>Evolvulus alsinoids</i>	Convolvulaceae	Herb	-----
66	<i>Gemnema sylvestre</i>	Asclepiadaceae	Leaves	Antidiabetic ^[92]
67	<i>Hamanthus multiflorus</i>	Amaryllidaceae	Bulb	-----
68	<i>Hedyotis herbaceae</i>	Rubiaceae	Whole plant	Hepatoprotective and Antibacterial ^[93] , Anti- inflammatory and Cytotoxic ^[94]
69	<i>Hedyotis puberula</i>	Rubiaceae	Leaves	Antiulcer ^[95] , Anti-inflammatory ^[96]
70	<i>Holostemma ada-kodien</i>	Asclepiadaceae	Root	Hepatoprotective ^[97]
71	<i>Hybanthus enneaspermus</i>	Violanaceae	Whole plant	Antidiabetic ^[98]
72	<i>Hypericum japonicum</i>	Hypericaceae	Herb	Hepatoprotective ^[99]
73	<i>Indigofera cassioides</i>	Fabaceae	Flower	Anticancer ^[100] , Antinociceptive ^[101]
74	<i>Indigofera tinctoria</i>	Fabaceae	Whole plant	Antibacterial and Cytotoxicity ^[102]
75	<i>Justicia procumbens</i>	Acanthaceae	Herb	Antiplatelet ^[103] , Hallucinogenic ^[104]
76	<i>Lawsonia inermis</i>	Lythraceae	Leaves	Anti-Inflammatory, Antipyretic and Analgesic ^[105]
77	<i>Lepidagathis incurve</i>	Acanthaceae	Leaves	Anti-Inflammatory, Analgesic and Antipyretic Effects ^[106]
78	<i>Leucas aspera</i>	Lamiaceae	Flower	antibacterial and cytotoxic ^[107]
79	<i>Leucas cephalotes</i>	Lamiaceae	Flower	analgesic and anti-inflammatory ^[108] , Hepatoprotective ^[109]
80	<i>Leucas lanata</i>	Lamiaceae	Shoots	Antimicrobial and Cytotoxic ^[110] , Antimicrobial ^[111]
81	<i>Luffa echinata</i>	Cucurbitaceae	Fruit	-----
82	<i>Machilus macrantha</i>	Lauraceae	Bark	Anti-inflammatory ^[112]
83	<i>Madhuca indica</i>	Sapotaceae	Flower	Anti-Inflammatory, Analgesic and Antipyretic ^[113]
84	<i>Madhuca longifolia</i>	Sapotaceae	Flower	Antihyperglycemic ^[114]
85	<i>Marsdenia tenacissima Roxb</i>	Asclepiadaceae	Root	Anti - angiogenic ^[115] , Anti-tumor ^[116]
86	<i>Mimosa pudica</i>	Mimoseaceae	Root	Anti-inflammatory ^[117]
87	<i>Monochoria vaginalis</i>	Pontederiaceae	Leaves & roots	Anti-nephrotoxic ^[118] , Anti-Inflammatory ^[119]
88	<i>Moringa concanensis</i>	Moringaceae	Root	Anticancer ^[120] , Anti-convulsant ^[121]
89	<i>Mucuna monosperma</i>	Fabaceae	Seeds	Neuro-protective ^[122]
90	<i>Mucuna nigricans</i>	Fabaceae	Stem	-----
91	<i>Mussaenda erythrophylla</i>	Rubiaceae	Root	Hepatoprotective ^[123]
92	<i>Mussaenda frondosa</i>	Rubiaceae	Leaves	Diuretic ^[124] , Hypolipidemic ^[125]
93	<i>Nicotiana tobacum</i>	Solanaceae	Leaves	Antimicrobial ^[126]
94	<i>Ochna obtusata</i>	Ochnaceae	Root	Hypolipidemic ^[127] , Anti-Ulcer ^[128]
95	<i>Ocimum americanum</i>	Lamiaceae	Leaves	Anti-inflammatory ^[129]
96	<i>Ocimum basilicum</i>	Lamiaceae	Leaves	Antiviral ^[130] , Gastric antiulcerogenic ^[131]
97	<i>Ocimum tenuiflorum</i>	Lamiaceae	Leaves	-----
98	<i>Osbeckia chinensis</i>	Melastomataceae	Root	Hypoglycemic and Anti-hyperglycemic ^[132]
99	<i>Pergularia daemia</i>	Asclepiadaceae	Leaves	Analgesic, antiinflammatory and

				antipyretic ^[133] , Diuritic ^[134]
100	Phyllanthus reticulatus	Euphorbiaceae	Root	Immunostimulant ^[135] , Anticancer ^[136]
101	Piper hymenophyllum	Piperaceae	All parts	Antimicrobial ^[137]
102	Piper longum	Piperaceae	Fruit	Antiplatelet ^[138]
103	Piper nigrum	Piperaceae	Fruit	Antimicrobial ^[139]
104	Pittosporum napaulense	Pittosporaceae	Bark	-----
105	Polygala chinensis	Polygalaceae	Leaves	Anti-inflammatory ^[140]
106	Portulaca quadrifolia	Portulacaceae	Herb	-----
107	Psuedarthria viscid	Fabaceae	Root	Antidiabetic ^[141]
108	Pueraria tuberosa	Lamiaceae	Root	Anticonvulsant ^[142] , Anti-inflammatory ^[143]
109	Punica granatum	Punicaceae	Flower buds	Antibacterial ^[144]
110	Ruellia tuberosa	Acanthaceae	Leaves	Antimicrobial ^[145]
111	Rungia repens	Acanthaceae	Herb	Anti-inflammatory, Diuritic and antimicrobial ^[146]
112	Salacia oblonga	Hippocratiaceae	Root	Hypoglycemic ^[147] , Postprandial hyperlipidemia and hepatic steatosis ^[148]
113	Salvadora persica	Salvadoraceae	Leaves	Antifungal ^[149]
114	Sarcostemma acidum Roxb	Asclepiadaceae	Whole plant	Antiulcer ^[150]
115	Scindapsus officinalis	Araceae	Fruit	Antiinflammatory and analgesic ^[151] , Anticancer ^[152]
116	Scleria levis	Cyperaceae	Fruit	-----
117	Scoparia dulcis	Scrophulariaceae	Leaves	Sedative and Hypnotic ^[153] , Antidiabetic ^[154]
118	Solanum anguvi	Solanaceae	Roots	Hypoglycemic and Antihyperglycemic ^[155]
119	Solanum melangina	Solanaceae	Roots	Antipyretic and analgesic ^[156] , Hypotensive ^[157]
120	Solanum seaforthianum	Solanaceae	Flower,fruit	Antiinflammatory ^[158]
121	Solanum surattensis	Solanaceae	Roots	Analgesic ^[159]
122	Solanum torvum	Solanaceae	Whole plant	Antiinflammatory ^[160] , Immunomodulatory and erythropoietic ^[161]
123	Spacranthus indicus	Asteraceae	Roots	Antidiabetic ^[162]
124	Stemona tuberosa	Stemonaceae	Root	-----
125	Tagetes erecta	Asteraceae	Herb	-----
126	Tectona grandis	Verbinaceae	Flower	Antidiabetic ^[163]
127	Tephrosia hamiltonii	Fabaceae	Leaves	Gastroprotective ^[164]
128	Terminalia arjuna	Combretaceae	Bark	Antihelminthic ^[165]
129	Tetrastigma lanceolarium	Vitaceae	Whole plant	-----
130	Todalia asiatica (L)	Rutaceae	Leaf, fruit	Antinociptive and anti-inflammatory ^[166]
131	Tragia plukenetii	Euphorbiaceae	Root	Antinociptive ^[167] , Antihyperglycemic ^[168]
132	Trianthemportulacastruma	Aizoaceae	Root	Heptoprotective ^[169]
133	Trichosanthes cucumeriana	Cucurbitaceae	Root&fruit	Gastroprotective ^[170] , Anti-inflammatory ^[171]
134	Trichosanthes tricuspidata	Cucurbitaceae	Root	Anti-hyperglycemic ^[172] , Anticancer ^[173]
135	Turnera ulmifolia	Tumeraceae	Whole plant	Antimicrobial and Anticancer ^[174]
136	Tylophora indica	Asclepiadaceae	Leaf and root	Diuretic ^[175] , Hepatoprotective ^[176]
137	Utricularia stellaris	Lentibulariaceae	Leaves	-----
138	Vanda spathulata	Orchidaceae	Flower	Nootropic ^[177] , Antidepressant ^[178]
139	Vicoa auriculata	Asteraceae	Leaf	-----
140	Zaleya decandra	Aizoaceae	Root	Antidiabetic ^[179]
141	Zornia gibosa	Fabaceae	Whole plant	Anti-inflammatory ^[180]

CONCLUSION

At present, asthma has a permanent control in Ayurveda as “Amoksha Ayurveda”. It has no artificial supplements and zero side effects with 98% success rate. The medicinal and aromatic plants mentioned in this review have been used in the control of asthma since ancient days. Most of all these plants are available in the different regions of India, especially in Andhra Pradesh. Among these medicinal plants most of them are not

explored in scientific way for their clinical utility. As we know, the importance of herbal medicine enhancing tremendously, because the treatment with herbal medicine have less or no side effects comparing with allopathic treatment. There is a challenge beyond the researchers to full fill the public utility in the control of asthma, by identify and developing the Liukotrien Inhibitors (5-Lipoxigenase Inhibitors), because these liukotriens, LTB₄, LTC₄ and LTD₄ are the main mediators

of asthma. The uncontrolled productions of these biological products are responsible for the manifestation of asthma. Thus, lipoxygenase is being used as the target for the development of new drugs in the treatment of asthma. All the medicinal and aeromtic plants mentioned in this review have vital importance in the management of asthma.

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