Review Article

A Review on Phytoconstituents Against Asthma

Sangilimuthu A*[1], Sathishkumar R[2], Teepica Priya Darsini D[3], Anitha J[4], Ravi Subban[5]
*1&3Department of Biotechnology, Karpagam University, Coimbatore, Tamilnadu, India.
[2]Department of Biotechnology, Bharathiar University, Coimbatore, Tamilnadu, India.
[4]Department of Bioinformatics, Karpagam University, Coimbatore, Tamilnadu, India.
[5]Department of Chemistry, Karpagam University, Coimbatore, Tamilnadu, India.
***Corresponding author's E-mail:** smuthu.al@gmail.com

Accepted on: 07-09-2014; **Finalized on:** 31-01-2015.

ABSTRACT

From ancient times plants have been utilized as a source of medicine for asthma. Asthma is a chronic respiratory disease and it affects all age groups of peoples, currently available anti-asthmatic drugs have adverse effects therefore phytotherapeutic provides idea for producing new anti-asthmatic drugs to overcome the problem. This review affords a preview of the recent findings on some medicinal plants having anti-asthmatic effect and chemical constituents isolated from them. Constituents from the medicinal plants have been the major source for treatment of asthma and their traditional usage as medicine on the basis of experiences and traditional practitioner. The search for new and high value compounds is constantly enduring with lofty efficiency followed a squat-regularity of adverse-effect drugs still need to be identified. Medicinal plants provide potential leads to find active molecules against asthma such as phenolics, sterol and terpenoids are a major class of phytoconstituents against asthma.

Keywords: Bronchospasm, Anti-asthma, Phytomedicine, Anti-asthmatic drugs, bronchocontraction and Histamine.

INTRODUCTION

Asthma is a chronic respiratory disease in the airway characterized by episodes of wheezing, shortness of breath, coughing and chest pain. The common elicit of asthma such as airway irritants like tobacco smoke, air pollution, allergens, respiratory infections, stress, mold and termites and it is caused through genetic and environmental factors also the asthma attack begins, when the allergen inhaled through respiration and it binds to the IgE antibodies on mast cell in the lung and the mast cell produced histamine, leucotrienes[1]. These biologically active mediators cause the smooth muscle cells or bronchial contract. This cause narrowing the luman of the bronchi due to the accumulation of eosinophils. The repeated attacks or accumulation of eosinophils causes bronchial damage in the lung. In the late stage of the asthma attacks is difficult to breathing due to the smooth muscle cells in the bronchi constrict, and the airway become inflamed and swollen. Asthma is typified by airway eosinophilia, edema, mucus hypersecretion, bronchial epithelial injury and hyperactivity. Disease pathogenesis includes contributions from several cell types including airway epithelial cells, eosinophils, macrophages, dendritic cells, T-helper type 2 (Th2) cells, IgE-secreting B cells and mast cells, as well as changes in bronchoalveolar lavage fluid (BALF)[2]

Nearly 300 million people suffered from asthma in worldwide and 2, 50, 000 annual deaths were recorded due to asthma. The prevalence rate of asthma in the last five years was gradually increased[3]. The present treatment methods and resources for asthma have low effectiveness and related to adverse effects subjected to fulfillment[4]. In view of the above, plants is a major source of human being as a natural medicine and it saved their lifetime from various diseases with their bioactive properties used in the modern medicine[5]. However, the systematic evidence sustaining the worth of herbal treatment is imperfect. There are few well-preventive mechanism of studies that maintain the efficacy of herbal remedies in the treatment of asthma. Existing systematic confirmation has not yet established the strength of their accepted role in the treatment of asthma[6]. The present review appraises the effective medicinal plants and their efficacy in asthma to afford a reasonable point of view of scientific information on herbal therapy and isolated bioactive compounds.

MATERIALS AND METHODS

Methodology

A literature search was carried from Science Direct and various other journals and following were the keywords used: Medicinal plants used to treat asthma, bronchodilation effect, anti-asthmatic activity of medicinal plants, phytotherapy, plants possess anti-asthma properties, isolation and characterization of phytoconstituents against asthma.

Medicinal Plant possess Anti-Asthmatic Effects

The methanolic extract of aerial parts of *Abutilon indicum* (Figure 1) (250 and 500 mg /kg b.w.) exhibited mast cell stabilizing effect against compound 48/80 and egg albumin induced rat peritoneal mast cell degranulation (Archana and Anita Mehta). The whole plant of *Abutilon indicum* contains luteolin, chrysoeriol, luteolin 7-O-beta-glucopyranoside, chrysoeriol 7-O-beta-glucopyranoside,

apigenin 7-O-beta-glucopyranoside, quercetin 3-O-beta-glucopyranoside, quercetin 3-O-alpha-rhamnopyranosyl (1 --> 6) -beta-glucopyranoside[7], β-sitosterol[8], p-b-D-Glucosyloxybenzoic acid, p-Hydroxybenzoic, Caffeic acid[9], alantolactone and isoalantolactone[10].

Adhatoda vasica (Figure 2) usually called as Vasaka in India and it is used for various diseases and disorders especially for respiratory disease. In Ayurveda, the juice of *A. vasica* leaves and root used for curing asthma, bronchitis and other chronic coughs. The leaf powder has used for bronchial asthma by the way of smoking (dhoomapana). *Adhatoda vasica* have a protective effect against allergen-induced bronchial obstruction in guinea pigs. The *A. vasica* contain galactoside, 0-ethyl-z-D-galactoside, sitosterol P-D-glucoside, D-galactose and deoxyvasicinone[11].

The methanolic extract of *Ailanthus excelsa* (Roxb) (Figure 3) stem bark reduced muscle contraction at 100µg/ml in isolated guinea pig ileum preparation and the latent period of convulsions was increased as the dose of 400mg/kg, b.w. in histamine aerosols exposed bronchoconstriction compared with chlorpheniramine maleate used as standard. The percentage protection significantly increased and found 59.4% protection against histamine induced bronchospasm in guinea pig[12]. *Ailanthus excelsa* contain quassinoid, dehydroexcelsin, glaucarubol, sitosterol, 2,6-dimethoxybenzoquinone, malanthin[13], vitexin, glaucarubin, excelsin, ailanthinone, glaucarubinone and glaucarubol 15-isovalerate, 13,18-dehydroglaucarubol 15-isovalerate alkaloids[14], 3S,24S,25-Trihydroxyttirucall-7-ene[15], quassinoids, 3, 4-dihydro excelsin, quassinoids excelsin, glaucarubine, ailanthinone, glaucarubinone, glaucarubolone[16] and tetracyclic Triterpenes[17].

The decoction of *Albizzia lebbeck* (Figure 4) bark (0.25 g – 1.0 g/kg b.w.) and flower (50 mg/kg b.w.) significantly protected against histamine induced bronchospasm in guinea pig and found the flower decoction significantly high compared to the bark extract. The bark and leaves of *Albizzia lebbeck* contain catechins, kaempferol, quercetin, lupeol, α-amyrine, Albizia saponins A, B, and C, triterpenoids and albizinin, among them, saponins were reported to inhibit degranulation of mast cells[18-21] and tri-0-glycoside flavonols kaempferol[22].

The traditional medicinal herb of *Artemisia scoparia* (Figure 5) Waidst flower and buds extracted and their purified the active anti-asthmatic novel component scoparone was isolated, evaluated the pharmacokinetics analysis by using HPLC system showed fast reaction and removal with small accumulation showed in blood plasma in Sco administered by intravenous at a dose of 2.0 or 3.6 mg/kg.b.w. in rabbit animal model.

The same content possess anti-asthmatic activity by spray inhalation method. The Sco easily administered by spray inhaler and it is easily digested, eliminate from the body and very less adverse effect[23]. The root of *Artemisia scoparia* contains artemisterol C, tetraterpenoid (scoparoic acid) and artemilanosterol[24].

Ethyl acetate, hexane and methanol extract of *Asystasia gangetica* (Figure 6). T. Adams leaves has reveled their anti-asthmatic potentials against 5-hydroxytriptamine on rat fundus strip preparation. The result found among the solvent extracts the ethyl acetate extract was potentially high tissue contraction effect same way tracheal chain muscle contraction, the methanol extract has low inhibitory activity against histamine induced guinea pig[25]. The leaves contain the terpenoid. The leaves of *Asystasia gangetica* are used for the management of asthma among the Nigerian peoples in traditionally.

From methanolic fruits pulp extract *of Balanites aegyptiaca* (Figure 7) fractionated by n-butanol revealed their anti-asthmatic potentials by various pharmacological experiments such as mast cell degranulation in horse serum induced albino rat, acetylcholine and histamine aerosol induced bronchospasm and ileal contractions in guinea pigs and histamine induced contraction in goat tracheal chain preparation in various dose levels at 50, 100 and 200 mg/kg b.w. evaluated and found potent anti-asthmatic effect due to the mast cell stabilizing capability and reduced level of eosinophils count. The bark root and leaves of *Balanites aegyptiaca* contain Balanin B1 and Balanin B2[26], gentisic, p-coumaric, caffeic, ferulic and sinapic acids[27].

Exhibited anti-asthmatic activity in the ethanolic extract of the stem bark of *Balanites roxburghii* Planch, the resulted showed the increase in the contractile responses of the tissue significantly, when treated with different concentration of the extract against acetylcholine (0.5%) and histamine (0.25%) aerosol induced guinea pig[28]. *Balanites roxburghii* contains steroidal saponins, deltonin and Protodeltonin[29].

The methanolic extract of *Benincasa hispida* (Figure 8) (Thunb.) fruits having potent anti-asthmatic activity against histamine acid phosphate and acetylcholine chloride induced bronchospasm in guinea pig. The isolated active compounds of triterpenes, alunsenol and multiflorenol from this plant exhibit mast cell stabilizing effect in a rat animal model[30]. *Benincasa hispida* contains astilbin catechin naringenin[31], triterpenes, phenolics, sterols and glycosides[32]. The ethanolic extract of the aerial part with the fruit of *Bryonia laciniosa* (Figure 9) Linn posses anti-asthmatic effect by a mesenteric mast cell count of the Atopic allergy method against triple antigen induced rats and found 56.27% protection has been recorded[33].

The extract of *Citrus grandis* (Figure 10) posses anti-asthmatic activity of histamine and acetylcholine induced guinea pig resulted significantly reduced the asthmatic severe in asthma induced animal model[34]. The root of *Citrus grandis* contains acridone alkaloids, grandisinine, grandisine-I, grandisine-II, coumarin, 5-methoxyseselin[35],

flavone, honyucitrin, coumarin, honyudisin, acridone alkaloids[36], Buntanme, prenylated acrldone alkaloid and cltrubuntin[37].

Curcumin is a major bioactive compound isolated from the rhizome of *Curcuma longa* has prevented the Oval albumin (OVA) challenged airway construction in male guinea pig animal with dose level of 20 mg/kg b.w. and also it regulates Th1/Th2 cytokine production, T-bet and GATA-3 gene expression in OVA induced asthma in mice[38]. In OVA induced mice the level of IL-4, Th2 cytokine has decreased and increased level of IFN-γ, Th1 cytokine after administration of Quercetin, it shows the Quercetin inhibits asthmatic reactions in asthma induced murine mice[39].

It has been used for treatment of asthma as traditional medicine. Fractionated ethanolic extract of *Elaeagnus pungens* leaf (Figure 11) have evaluated. The results found a relaxant effect on the bronchocontraction in guinea pigs of the water fraction is most active compare to the petroleum ether fraction, ethyl acetate fraction, 1-butanol fraction by liquid-liquid extraction and also the petroleum ether fraction and water fraction possess anti-asthmatic activity by *in vivo* method in asthma induced guinea pig[40]. The bark extract of *Elaeagnus pungens* contains pungens A-C, phenol glycosides, secoiso-flavanol and phenol ether[41].

The BALB/c of asthmatic mouse with hydrocortisone and aqueous extract *Euphorbia hirta* (Figure 12), showed an equal reduction of asthma with hydrocortisone administered mouse showed the weight loss compared to the standard drug administered mouse. Therefore the *Ephorbia hirta* possess anti-asthmatic activity against allergen challenged animal[42]. ß-Amyrin[43] triterpénicos; b-amirina, 24-metilencicloartenol, y b-sitosterol and fueron[44] has reported in *Euphorbia hirta*.

Ficus religiosa (Figure 13) is popularly called as Bothi tree among the Indian communities and also an important medicinal plant for curing asthma among the Indian culture and also it has used for cough and other respiratory disorders. The methanolic extract of *Ficus religiosa* fruits exhibited anti-asthmatic properties against histamine induced bronchospasm in guinea pigs and *in vitro* isolated guinea pig tracheal chain and ileum preparation methods, ketotifen (1mg/kg b.w.) is used as standard drug. The powder of fruit defatted with petroleum ether and extracted with methanol, containing serotonin in HPLC analysis[45].

The isolated 4-hydroxy-3-methoxy benzaldehyde from the methanolic extract of *Gastrodia elata* rhizome (Figure 14) have potent anti inflammatory activity. The isolated phenolic compound from rhizome showed posses anti-asthmatic activity against OVA induced guinea pig.

The anti-asthmatic activity was tested *in vivo* and *in vitro* the measurement of airway function and Brochoalveolar lavage and cytologic examination as *In vivo* method, histamine assay, PLA_2 activity assay, EPO assay as an *in vitro* method[46]. The root of *Gastrodia elata* contains 4-hydroxy-3-methoxybenzaldehyde, 4-Hydroxy-3-methoxybenzyl alcohol, hydroxy-3-methoxybenzyl alcohol, bis-(4-hydroxyphenyl) methane, 4-hydroxy-3-methoxybenzoic acid and 4-hydroxy-3-methoxybenzaldehyde, parishin showed anti plate let activity reported by Pyo[47].

The combination of fresh juice of *Helicteres isora* (Figure 15) with another formulation of medicinal plant properties to use to cure asthma as traditional medicine reported by Panda T[48]. The fruit of *Helicteres isora* contains isoscutellarein 4′-methyl ether 8-O-β-D-glucuronide 6″-n-butyl ester; isoscutellarein 4′-methyl ether; 8-O-β-D-glucuronide 2″, 4″-disulfate and isoscutellarein 8-O-β-D-glucuronide 2″,4″-disulfate[49].

The alcoholic extract of *Moringa oleifera* (Figure 16) seed (100mg and 200mg/kg b.w.) pretreated against histamine and acetylcholine exposed guinea pig, the PCT increased and found 36.13 ± 3.36 & 56.31 ± 3.11 % protection respectively at 200 mg/kg b.w. compared with ketotifen fumarate. The mast cell degranulation also were tested against egg albumin and 48/80 compound induced mast cell degranulation found significantly inhibited at the dose level of 0.5mg – 2.0mg/ml[50]. Muscle contraction was evaluated at the dose level of (50-150mg/ml) on guinea pig ileum preparation induced by various agonist histamine, ACH, 5HT, $BaCl_2$, high % contraction found at 150 mg/ml dose i.e. 65.48 ± 1.24, 38.44 ± 1.09, 72.21 ± 0.47 and 80.74 ± 0.99 respectively. Seed powder administered to the asthma patients found significant reduction of asthma problems among the asthmatic patients and also tested the lung functions resulted increase the lung function of all the asthmatic patients compared to the standard drug, it shows the seed possess anti-asthmatic potentials[51]. The 4-(α-L-rhamnopyranosyloxy) benzyl isothiocyanate, methyl N-4-(α-L-rhamnopyranosyloxy) benzyl carbamate and 4-(β-D-glucopyranosyl-1→4-α-L-rhamnopyranosyloxy)-benzyl thiocarboxamide[52] reported from seed extract.

The ethanolic extract of *Ocimum sanctum* (Figure 17) inhibited degranulation of mast cell at the dose level of 100 and 200 mg/kg b.w. with 62.44% and 67.24% protection respectively, same manner the isolated flavanoid fraction of *Ocimum sanctum* also tested and found 54.62 and 60.48% protection at the dose level of 75 and 150 mg/kg b.w. respectively compared with prednisolone administered animal model[53]. The leaves of *Ocimum sanctum* contain cirsilineol, cirsimaritin, isothymusin, isothymonin, apigenin, rosmarinic acid, eugenol[54], β-sitosterol-D-glycoside[55], eugenol, urosolic acid, carvacrol, linalool, limatrol, caryophyllene and Estragol (leaf oil), sitosterol (seed), Orientin and Vicenin[56].

Diethyl ether, ethanol and aqueous extracts of *Siphonochilus aethiopicus* (Figure 18) possess anti-asthmatic efficacy by *in vivo* animal model and also the *in vitro* glucocorticoid and histamine H_1 receptor binding assay were performed with phosphodiesterase IV activity

from the diethyl ether extract of *Siphonochilus aethiopicus* against asthma[57]. *S aethiopicus* contain furanoterpenoids[58].

The well known food vegetable and medicinal plant of *Tamarindus indica* Linn (Figure 19) used to cure asthma as folk medicine. The methanolic leaves extract posses anti-asthmatic activity at the dose level of 175, 350 and 700 mg/kg b.w. against clonidine induced mast cell degranulation in rats and also considerably reduced the milk induced leucocytes and eosinophilia in mice[59].

Aqueous extract of *Taxus baccata* (Figure 20) leaves (200 and 400 mg/kg b.w.) has protective anti acute bronchoconstriction against histamine and acetylcholine aerosol induced bronchospasm in guinea pig, and suppressed the level of total leukocyte and differential leukocyte count in the BALF of the egg albumin sensitized guinea pigs Aqueous extract of *Taxus baccata* possess peritoneal mast cell degranulation induced by compound 48/80 compared with ketotifen administered[60] and also it suggest that aqueous extract of the *T. baccata* possess bronchodilating effect. The young stem wood contains taxoid, 10-deacetyltaxezopidine G, and Taxezopidine G[61] lariciresinol and taxiresinol[62].

The fresh bark extract of *Terminalia arjuna* (Figure 21) has potent anti-asthmatic effect by combinational preparation with some of other medicinal plants as traditional medicine. The *Terminalia arjuna* contains arjunic acid, arjungenin, arjunetin and arjunoglucoside I[63] and oleanane-type triterpene glycosides[64].

The ethanolic extract of *Viola mandshurica* (Figure 22), W. Becker appreciably raised the total immunoglobulin E (IgE), cytokines IL-4, IL-13 levels in serum and bronchoalveolar lavage fluid and also it has potentially reduced airway hyperresponsiveness (AHR), eosinophilia and mucus hypersecretion in OVA-challenged asthmatic female mice compared with dexamethasone administered mice reported by Lee[65].

Rumex gmelini and *Clerodendron trichotomum* (Figure 23) has been used for inflammatory disease as folk medicine and also the isolated compound of acteoside β-(3,4-dihydroxyphenyl)ethyl-O-α-Lrhamnopyranosyl (1→3)-β-D-(4-O-caffeoyl)-glucopyranoside from the leaves of *Clerodendron trichotomum,* significantly inhibited the specific airway resistance during Immediate phase asthmatic response (IAR) and late phase asthmatic response (LAR) and also the isolated compound of caffeic acid and its glycosides, caffeoyl glycoside (1-O-caffeoyl-β-D-glucopyranoside) form the aerial part of *Rumex gmelini* have potent anti-athmatic activity against ovalalbumin induced guinea pig animal model reported by Lee[66].

The methanolic extract of *Abrus precatorius* (Figure 24) leaves evaluated the bronchodilating effect against histamine induced bronchoconstriction at the dose level of 30, 100, 300 mg/kg b.w.

Each dose effects to extend the PCT and high protection found at 300 mg/kg b.w. dose (41.62) compared to salbutamol used as standard (47.52%)[67].

Triterpenoid saponins have been reported from Aerial part of *Abrus precatorius*[68].

Aqueous extract of *Pistacia integerrima* galls showed mast cell degranulation effects of antigen (horse serum along with triple antigen vaccine) challenged albino rats and also it shows significant protection against histamine aerosol-induced bronchospasm in guinea pigs, spasmolytic activity against histamine induced contractions in isolated guinea pig tracheal chain preparation[69].

Aqueous bark extract of *Myrica nagi* possess high mast cell degranulation effects at the dose levels of 27 and 54 mg/kg p.o.

This shows extract may be possibly due to the membrane stabilizing potential, suppression of antibody production and inhibition of antigen induced histamine release[70].

Zeal herbal granules showed significant protection of rat mesenteric mast cells from disruptions caused by compound 48/80 and also the herbal formulation possess anti-asthmatic activity.

It is polyherbal formulations containing mainly the ingredients of *Glycyrrhiza glabra, Cinnamomum tamala, Adhatoda vasica, Ocimum sanctum, Zingiber officinale, Terminalia bererica, Piper longum, Piper nigrum, Emblica officinalis, Cassia occidentalis, Solanum xanthocarpum, Cinnamomum zeylanicum, Curcuma longa, Sarcostemma acidum* and *Tylophora asthmatica*[71].

Figure 1: *Abutilon indicum*

Figure 2: *Adhatoda visica*

Figure 3: *Ailanthus excelsa*

Figure 4: *Albizia lebbeck*

Figure 5: *Artemisia scoparia*

Figure 6: *Asystasia gangetica*

Figure 7: *Balanites aegyptiaca*

Figure 8: *Benincasa hispida*

Figure 9: *Bryonia laciniosa*

Figure 10: *Citrus grandis* f.

Figure 11: *Elaeagnus pungens*

Figure 12: *Euphorbia hirta*

Figure 13: *Ficus religiosa*

Figure 14: *Gastrodia elata*

Figure 15: *Helicteres isora*

Figure 16: *Moringa oleifera*

Figure 17: *Ocimum sanctum*

Figure 18: *Siphonochilus aethiopicus*

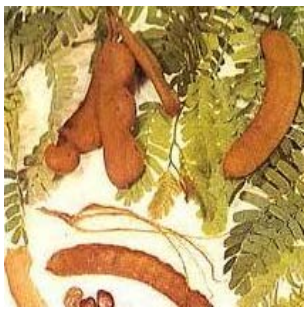

Figure 19: *Tamarindus indica*

Figure 20: *Taxus baccata L*

Figure 21: *Terminalia arjuna*

Figure 22: *Viola mandshurica*

Figure 23: *Clerodendron trichotomum*

Figure 24: *Abrus precatorius*

Table 1: Name of currently using Anti-Asthmatic drugs and their side effects.

Name of the drug	Function	Side effects
Cortisone Drugs (Steroids)	Reduce inflammation by minimizing swelling of airways.	Hairiness, stunted growth, increased appetite, weight gain, round face, abdominal pain, increased blood pressure, cataracts, dry mouth, bruising, fatigue, leg cramps and increased perspiration.
Bronchodilators: Beta-agonists Theophylline Anticholinergic	Relieve coughing, wheezing, shortness of breath, and difficulty in breathing	Nausea, vomiting, headaches, nervousness, restlessness, insomnia. Jitters, tremors, flushing, headaches, rapid and/or irregular heart rate, Sore and dry throat, muscle cramps and muscle twisting[76-77]. Intestinal discomfort, nausea, vomiting, shakiness, diarrhea, headaches, insomnia, depression, increased and/or irregular heart rate, leg cramps. Headaches, dry mouth and coughing.
Corticosteroids	Anti-inflammatory	Trauma, surgery, infection, candidacies (thrush), dysphonia, hoarseness, dry mouth, coughing, increased appetite, fluid retention, weight gain, mood swings, increased cholesterol, stunted growth, osteoporosis, dermal thinning, diabetes, cataracts, and muscle weakness [78].
Systemic corticosteroids	Minimizes exacerbation and reverses inflammation	Growth suppression, osteoporosis, dermal thinning, increased cholesterol, diabetes, cataracts, muscle weakness, increased appetite, fluid retention, weight gain and mood alteration.
Aerosol drugs	Asthma relief	Irritant for eyes, skin, respiratory system, bloodstream and nervous system.
Antihistamines	Relief allergy attacks	Drowsiness, dry mouth, constipation, confusion, nightmares, nervousness, restlessness and irritability
Decongestants	Treat nasal congestion	Nervousness, sleeplessness, increased blood pressure
Anti-Inflammatory Medication	Reduce inflammation in airways	Ulcers, weight gain, cataracts, weakening bones, high blood pressure, increased blood sugar, easy bruising and coughing.
Intal or Cromolyn sodium	Causes air tubes to be less reactive and less likely to spasm	Throat irritation, headaches, hives, abdominal pain, diarrhea, vomiting, insomnia, depression, cough and runny nose.
Mast Cell Inhibitors: Cromolyn Sodium and Nedocromil	Used as preventive treatment before exercise or exposure to allergens	Throat irritation, dryness, bad taste, and coughing.
Methylxanthines	Helps to control night time asthma symptoms.	Insomnia, abdominal pain, nausea, vomiting, central nervous system stimulation, headaches, seizures, hematemesis and hyperglycemia.
Leukotriene Modifiers	Alternative to low-dose inhaled corticosteroid therapy	Increase in liver enzymes, reversible hepatitis and hyperbilirubinemia.

DISCUSSION AND CONCLUSION

Medicinal plants are a major source of human being as a natural medicine and it saved their lifetime from various diseases with their bioactive properties.

Most of the modern medicines originate from the traditional herbal medicine. More than 100 plant species were used against respiratory disease especially asthma in tribal communities in the form of decoction, juice and dry powder[72-75].

Most of the synthetic drugs have adverse effects (Table 1), in view to overcome this adverse effect using a biological approach with medicinal plants to find phytotherapeutic without side effect.

The review appraises what are genes encoded for asthma (Table 2) and list the pharmacological technique to evaluate the medicinal plant's efficacy against asthma (Table 3), appilying these pharmacological techniques, the listed medicinal plants (Table 4) has proved as an anti-asthmatic agent in crude form and also isolated constituents form and their phytochemical profiles.

The Table 4 shows the majority of the plants reported against asthma containing Phenolics, sterol and terpenoids are a major class of Phyto-constituents were present and also the list shows some of the anti-asthmatic plants containing flavanoids, alkaloids, phenolic acids, saponins and glycosides linkage compounds.

Table 2: Genes associated with Asthma

GSTM1	*IL10*	*CTLA-4*	*SPINK5*
LTC4S	*LTA*	*GRPA*	*NOD1*
CC16	*GSTP1*	*STAT6*	*NOS1*
CCL5	*TBXA2R*	*TGFB1*	*IL4*
IL13	*CD14*	*HLA-DRB1*	*HLA-DQB1*
TNF	*FCER1B*	*IL4R*	*ADAM33*

Table 3: Various Experiments and Inducers were used for Anti-Asthmatic Activity

Histamine induced Isolated Guinea pig Ileum preparation by *in vitro*
Histamine induced guinea pig- Isolated tracheal chain preparation by *in vitro*
Acetylcholine induced bronchospasm in guinea pig by *in vivo*
Oval albumin (OVA) challenged airway construction in guinea pig by *in vivo*
Histamine induced bronchocontraction in guinea pigs by *In vivo.*
Allergen induced mast cell degranulation

Table 4: Plants reported against Asthma and their isolated Phytochemical Constituents

S.No.	Name of the Plant and Family	Parts used for Asthma	Isolated Compounds
1	*Abutilon indicum* Malvaceae	whole plant Flowers, leaf	luteolin, chrysoeriol, luteolin 7-O-beta-glucopyranoside, chrysoeriol 7-O-beta-glucopyranoside, apigenin 7-O-beta-glucopyranoside, quercetin 3-O-beta-glucopyranoside and quercetin 3-O-alpha-rhamnopyranosyl (1 --> 6)-beta-glucopyranoside[79,7] β-sitosterol[8] *p*-b-D-Glucosyloxybenzoic acid, *p*-Hydroxybenzoic and caffeic acid[9] alantolactone and isoalantolactone[10]
2	*Adhatoda visica Justicia gendarussa* Acantheceae	roots	9-acetamido-3,4 dihydropyrido-(3,4-b)-indole 0-ethyl-z-D-galactoside sitosterol P-D-glucoside and deoxyvasicinone[11]
3	*Ailanthus excels* Simaroubaceae	bark	quassinoid, dehydroexcelsin, glaucarubol sitosterol, 2,6-dimethoxybenzoquinone malanthin, vitexin. glaucarubin and excelsin ailanthinone, glaucarubinone and glaucarubol 15-isovalerate 13,18-dehydroglaucarubol 15-isovalerate alkaloids. 3S,24S,25-trihydroxyttirucall-7-ene excelsin, glaucarubine, ailanthinone, glaucarubinone and glaucarubolone, Tetracyclic Triterpenes[12-17]
4	*Albizia lebbeck* Fabaceae	Bark and leaves and flower	catechins, kaempferol, quercetin, lupeol, α-amyrine, Albizia saponins A, B, and C, triterpenoids, glycoside and albizinin saponins kaempferol and quercetin 3-O+rhamnopyranosyl (1 4 6)-p glucopyranosyl, galactopyranosides[18-22]
5	*Artemisia scoparia* Asteraceae	Root flower and buds	Scoparone Sterol (artemisterol C), scoparoic acid and artemilanosterol[24]
6	*Asystasia gangetica* Acanthaceae	Leaves	terpenoid [25]
7	*Balanites aegyptiaca* Zygophyllaceae	Bark leaves and galls & Bark	Balanin-1 and Balanin-2 saponins[26] Gentisic, *p*-coumaric, caffeic, ferulic and sinapic acids[27]
8	*Balanites roxburghii* Simarubaceae	stem bark	steroidal saponins; (25*R* and *S*)-spirost-5-en-3β-ol; 3-*O*-[α-L-rhamnopyranosyl (1 → 2)]-[β-D-glucopyranosyl (1 → 3)-β-D- glucopyranosyl [1 → 4)]-β-D-glucopyranoside; deltonin and protodeltonin[29]
9	*Benincasa hispida* Cucurbitaceae	Fruits	Astilbin, catechin and naringenin[32] triterpenes, phenolics, sterols and glycosides[33]
10	*Citrus grandis* f. *Rutaceae*	root bark	acridone alkaloids, grandisinine, grandisine-I, grandisine-II an d 5-methoxyseselin[35] flavone, honyucitrin, honyudisin and acridone alkaloids[36]. Buntanme, prenylated acrldone alkaloid and cltrubuntin.
11	*Curcuma longa* Zingiberaceae	Rhizome	Curcumin (diferuloylmethane) and quercetin[39]
12	*Elaeagnus pungens* Elaeagnaceae	bark	pungens A-C, phenol glycosides, secoiso-flavanol and phenol ether[41]
13	*Euphorbia hirta* Euphorbiaceae	*whole plant*	ß-Amyrin (Terpenoid)[43] triterpénicos; b-amirina (1), 24-metilencicloartenol; y b-sitosterol and fueron[44]
14	*Ficus religiosa* Moraceae	Fruits	Serotonin[45]
15	*Gastrodia elata* Bl Orchidaceae	Roots	4-hydroxy-3-methoxybenzaldehyde, 4-Hydroxy-3-methoxybenzyl alcohol, hydroxy-3-methoxybenzyl alcohol, bis-(4-hydroxyphenyl) methane, 4-hydroxy-3-methoxybenzoic acid, and 4-hydroxy-3-methoxybenzaldehyde parishinaglycones, 4-hydroxybenzyl, 4,4'-dihydroxybenzyl sulfone, 10, 5-hydroxymethyl-2-furancarboxaldehyde, and 9, 4,4'-dihydroxy-dibenzylether, 4-hydroxybenzaldehyde[47]
16	*Helicteres isora* (sterculiaceae)	Whole plant	isoscutellarein 4′-methyl ether 8-O-β-D-glucuronide 6″-n-butyl ester, isoscutellarein 4′-methyl ether 8-O-β-D-glucuronide 2″, 4″-disulfate and isoscutellarein 8-O-β-D-glucuronide 2″,4″-disulfate[49].
17	*Moringa oleifera* Moringaceae	*Seed*	4-(α-L-rhamnopyranosyloxy)benzyl isothiocyanate, methyl N-4-(α-L-rhamnopyranosyloxy) benzyl carbamate and 4-(β-D-glucopyranosyl-1→4-α-L-rhamnopyranosyloxy)-benzyl thiocarboxamide[52]
18	*Ocimum sanctum* Linn Lamiaceae	Leaves Leaves Whole plant	cirsilineol, cirsimaritin, isothymusin, isothymonin, apigenin and rosmarinic acid [54] β-sitosterol-D-glycoside[55] eugenol, urosolic acid, carvacrol, linalool, limatrol, caryophyllene, estragol, sitosterol, Orientin and Vicenin[58]
19	*Siphonochilus aethiopicus* Zingiberaceae	-	Furanoterpenoids 1. 9a_-hydroxy- 4a_H-3,5_,8a_-trimethyl-4,4a,8a,9-tetrahydronaphtho-([2,3b]-dihydrofuran-2-one)-8-one, 2. 4a_H-3,5_,8a_-trimethyl-4,4a,8a,9-tetrahydronaphtho-([2,3b]-dihydrofuran-2-one)-8-one 3. 4a_H-3,5_,8a_-trimethyl-4,4a,8a-trihydronaphtho-([2,3b]-dihydrofuran-2-one)-8-one[56].
20	*Taxus baccata L.* Taxaceae	young stems *wood*	Taxoid, 10-deacetyltaxezopidine G and Taxezopidine G[61] lariciresinol and taxiresinol[62]
21	*Terminalia arjuna*	-	arjunic acid, arjungenin, arjunetin and arjunoglucoside I[63] oleanane-type triterpene glycosides
22	*Viola mandshurica* Violaceae	-	Rutin[65]
23	*Clerodendron trichotomum*	leaves	acteoside [˘-(3_,4_-dihydroxyphenyl)ethyl-O-¸-L-rhamnopyranosyl (1→3)-˘-d-(4-O-caffeoyl)-glucopyranoside][66]
24	*Rumex gmelini*	-	caffeic acid, glycosides, caffeoyl glycoside (1-O-caffeoyl- d-glucopyranoside
25	*Abrus precatorius*	Leaves	triterpenoid saponins[68]

From the Table 4, most of the plants used as a crude extract against asthma few has been isolated and tested their anti-asthmatic effects, i.e. scoparone from the fruit of *Artemisia scoparia,* triterpenes, alunsenol and multiflorenol from *Benincasa hispida* fruit, *curcumin from Curcuma longa* rhizome, ß-Amyrin (Terpenoid) from the aerial part of *Euphorbia hirta*, 4-hydroxy -3-methoxy benzaldehyde from the methanolic extract of *Gastrodia elata* rhizome, caffeoyl glycoside from the aerial part of *Rumex gmelini.*

These finds leads to go for further clinical trials against asthma with less side effect and rested anti-asthmatic plants such as *Abutilon indicum, Adhatoda visica, Ailanthus excelsa, Albizia lebbeck, Asystasia gangetica, Balanites aegyptiaca, Balanites roxburghii, Bryonia laciniosa, Citrus grandis, Elaeagnus pungens, Ficus religiosa, Helicteres isora, Moringa oleifera, Ocimum sanctum, Siphonochilus aethiopicus, Tamarindus indica, Taxus baccata, Terminalia arjuna, Viola mandshurica, Clerodendron trichotomum, Abrus precatorius, Pistacia integerrima*, *Myrica nagi*, *Glycyrrhiza glabra, Cinnamomum tamala, Zingiber officinale, Terminalia bererica, Piper longum, Piper nigrum, Emblica officinalis, Cassia occidentalis, Solanum xanthocarpum, Cinnamomum zeylanicum, Curcuma longa, Sarcostemma acidum* and *Tylophora asthmatica* lead for isolation of active anti-asthmatic phytoconstituents for future generation against asthmatic problems.

These may give natural anti-asthmatic drug with less adverse effect due to the biological sources of constituents.

From the above, Phenolics, sterol and terpenoids are a major class of Phytoconstituents against asthma. The present review concluded those are medicinal plants used in the form of crude extracts subjected to isolate their active phytoconstituents and evaluated by *In vivo / In vitro* rest of the constituent tested against asthma is subjected to evaluate with clinical trials and molecular interactions with various asthmatic targets have to be studied which provides valuable outcome.

Phyto-therapeutic will provide better treatment for asthma with lesser adverse effects.

Thus, this review paper will be useful to isolate and identify new bioactive compounds from these plants which serve as new anti-asthmatic drug with good enhancement.

This has become the primary lead to develop the modern and conventional drug development for Asthma.

Acknowledgement: The authors gratefully acknowledge the authorities of Karpagam University for providing necessary facilities to carry out this review process.

REFERENCES

1. Martinez FD, Genes, environments, development and asthma: a reappraisal, Eur Respir J, 29(1), 2007, 179–184.
2. Herrick CA, Bottomly K, To respond or not to respond: T cells in allergic asthma, Nature Reviews Immunology, 3, 2003, 405–412, doi: 10, 1038/nri1084.
3. Lara JA, National Health Statistics Report, 32, 2011.
4. Salib RJ, Drake-Lee A, Howarth PH, Allergic rhinitis: Past, Present and the future, Clinical Otolaryngology, 28, 2003, 291-303.
5. Agnihotri S, Wakode S, Agnihotri A, An overview on anti-inflammatory properties and chemo-profile of plants used in traditional medicine, Indian Journal of Natural product and resources, 1(2), 2010, 150-167.
6. Szelenyi I, Brune K, Herbal remedies for asthma treatment: Between myth and reality, Drugs Today, 38(4), 2002, 265.
7. Matławska I, Sikorska M, Flavonoid compounds in the flowers of *Abutilon indicum* (L) Sweet (Malvaceae), Acta poloniae pharmaceutica, 59(3), 2002, 227-229.
8. Abdul Rahuman A, Geetha G, Venkatesan P, Geetha K, Isolation and identification of mosquito larvicidal compound from *Abutilon indicum* (Linn,) Sweet, Parasitol Research, 102(5), 2008, 981-988, DOI: 10,1007/s00436-007-0864-5.
9. Pandey DP, Rather MA, Nautiyal DP, Bachheti RK, Phytochemical analysis of *Abutilon indicum,* International Journal of ChemTech Research, 3(2), 2011, 642-645.
10. Prem VS, Zafarul AA, Two Sesquiterpene Lactones from *Abutilon Indicum*, Phytochemistry, 28(12), 1989, 3525.
11. Jain MP, Koul SK, Dhar K, Atal CK, Novel nor-harmal alkaloid from *Adhatoda vasica,* Phytochemistry, 19, 1980, 1880-1882.
12. Kumar D, Bhujbal SS, Deoda RS, Mudgade SC, *In vitro* and *In vivo* antiasthmatic studies of *Ailanthus excelsa* (Roxb) on guinea pigs, Journal of Scientific Research, 2(1), 2010, 196-202.
13. Suroor AK, Shamsuddin KM, Isolation And Structure Of 13,18-Dehydroexcelsin, a Quassinoid, and Glaucarubol from *A1lanthus excelsa,* Phytochemistry, 19, 1980, 2484-2485.
14. Ravichandrana V, Sureshb B, Sathishkumarb MN, Elangob K, Srinivasanb R, Antifertility activity of hydroalcoholic extract of Ailanthus excelsa (Roxb): An ethnomedicines used by tribals of Nilgiris region in Tamilnadu, Journal of Ethnopharmacology, 112, 2007, 189–191.
15. Sherman M, Robert PB, Masaru Ogura, Geoffrey AC, Norman FR, 24 3s,24s,25-trihydroxyttirucall-7-ene from *Ailanthus excelsa* marl, Phytochemistry, 19, 1980, 1499-1501.
16. Bipin CJ, Anuj P, Ramoprakash S, Anakshi K, Quassinoids from *Ailanthus excelsa,* Phytochemistry, 62, 2003, 579–584.
17. Pullela V, Srinivas, Ranga Rao R, Madhusudana Rao J, Two New Tetracyclic Triterpenes from the Heartwood of *Ailanthus excelsa* Roxb, Chemistry and Biodiversity, 3(8), 2006, 930-934.
18. Tripathi RM, Das PK, Studies on anti-asthmatic and anti-anaphylactic activity of *Albizia lebbeck*, Indian Journal of Pharmacology, 9, 1977, 189–194.
19. Mukhopadhay B, Nagaraju K, Sharma KR, *Albizia lebbeck*: a remedy for allergic conjunctivitis, The Journal of Research and Education in Indian Medicine, 11, 1992, 17–23.
20. Agrawal PK, Singh B, Chemical constituents of *Albizia lebbeck*, Indian Journal Pharmaceutical Science, 53, 1991, 24–26.
21. Islam MN, Hiroyuki M, Masum S, Pichairajan V, Kazutaka M, Pulok KM, *Albizia lebbeck* suppresses histamine signaling by the inhibition of histamine H_1 receptor and histidine decarboxylase

gene transcriptions, International Immunopharmacology, 11(11), 2011, 1766-1772.

22. Amani MD, Mousallamy EL, Leaf flavonoids of *Albizia lebbeck,* Phytochemistry, 48(4), 1998, 759-761.

23. Fang Y, Li Z, Watanabe Y, Pharmacokinetics of a novel anti-asthmatic, scoparone, in the rabbit serum assessed by a simple HPLC method, Journal of Ethnopharmacology, 86, 2003, 127–130.

24. Sharmaa SK, Alib M, New Compounds from Roots of *Artemisia scoparia* Journal of Herbs, Spices & Medicinal Plants, 5(4), 1998, 77-86.

25. Ezike AC, Akah PA, Okoli CO, Bronchospasmolytic activity of the extract and fractions of *Asystasia gangetica* leaves, International Journal of Applied Research in Natural Products, 1(3), 2008, 8-12.

26. Speroni E, Cervellati R, Innocenti G, Costa S, Guerra MC, Anti-inflammatory, anti-nociceptive and antioxidant activities of *Balanites aegyptiaca* (L) Delile, Journal of Ethnopharmacology, 98, 2005, 117–125.

27. Medaa RNT, Vlaseb L, Lamien-Medac A, Lamiend CE, Munteanb D, Tiperciuce B, Identification and quantification of phenolic compounds from *Balanites aegyptiaca* (L) Del (Balanitaceae) galls and leaves by HPLC–MS, Natural Product Research, 25(2), 2011, 93-99.

28. Virendra S, Priyanka T, Patel JR, Kori ML, Dixit VK, Preliminary phytochemical and anti asthmatic studies on stem bark of *Balanites roxburghii* Planch, International Journal of Pharmaceutical and Clinical Research, 1(1), 2009, 40-42.

29. Dharam CJ, Antifeedant active saponin from *Balanites roxburghii* stem bark, Phytochemistry, 26(8), 1987, 2223-2225.

30. Anil Kumar D, Ramu P, Effect of methanolic extract Of *Benincasa hispida* against Histamine and acetylcholine Induced bronchospasm in guinea Pigs, Indian Journal of Pharmacology, 34, 2002, 365-366.

31. Qizhen D, Qi Z, Yoichiro I, Isolation and Identification of Phenolic Compounds in the Fruit of *Benincasa hispida* by HSCCC, Journal of Liquid Chromatography and related technologies, 28(1), 2005, 137-144.

32. Nurul Aqilah MZ, Farooq A, Azizah AH, Nazamid S, *Benincasa hispida* (Thunb,) Cogn: A potential source for valuable nutrients and functional foods, Food Research International, 44, 2011, 2368–2376.

33. Jayarama Reddy D, Gnanasekaran D, Vijay, Ranganathan TV, *In vitro* studies on anti asthmatic, analgesic and anti-convulsant activities of the medicinal plant *Bryonia laciniosa* Linn, International Journal of Drug Discovery, 2(2), 2010, 01-10.

34. Li PB, Ma Y, Wang YG, Su WW, Experimental studies on antitussive, expectorant and antiasthmatic effects of extract from *Citrus grandis* var, tomentosa, Zhongguo Zhong Yao Za Zhi, 31(16), 2006, 1350-1352.

35. Tian-Shung WV, Changsheng K, Hiroshi F, Acridone alkaloids and a Coumarin from *Citrus grandis,* Phyrochemistry, 22(6), 1983, 1493-1497.

36. Tian-Shung W, Shiow-chyn H, Ting-Ting J, Jeng-Shiow L, Chang-Sheng K, Coumarins, acridone alkaloids and a flavone from *Citrus grandis,* Phytochemistry, 27(2), 1988, 585-587.

37. Tian-Shung W, Alkaloids and coumarins of *Citrus grandis*, Photochemistry, 27(11), 1988, 3717-3718.

38. Arjun R, Moumita D, Balaram G, Curcumin Attenuates Allergen-Induced Airway Hyperresponsiveness in Sensitized Guinea Pigs, Biological & Pharmaceutical Bulletin, 26(7), 2003, 1021–1024.

39. Hee-ju P, Chang-Min L, In Duk J, Jun Sik L, Young-il J, Jeong Hyun C, Quercetin regulates Th1/Th2 balance in a murine model of asthma, International Immunopharmacology, 9, 2009, 261–267.

40. Yuebin G, Jiaqi L, Dongfang S, *In vivo* evaluation of the anti-asthmatic, antitussive and expectorant activities of extract and fraction from *Elaeagnus pungens* leaf, Journal of Ethnopharmacology, 126, 2009, 538-542.

41. Wu YB, Gu Y, Ouyang MA, Water-soluble constituents from the bark of *Elaeagnus pungens* and their cytotoxic activities, Journal of Asian Natural Product Research, 12(4), 2010, 278-285.

42. Ekpo OE, Pretorius E, Using the BALP/c asthmatic mouse model to investigate the effect of Hydrocortisone and a herbal asthma medicine on animal weight, Scandinavian Journal of Laboratory Animal Science, 35(4), 2008, 265-280.

43. Swati S, Tribhuwan S, Rekha V, Antimicrobial properties of ß-Amyrin (Terpenoid), Journal of Pharmacy Research, 3(8), 2010, 1979-1980.

44. Martinez V, Mariano A, Teresa OR, Lazcano ME, Anti-inflammatory active compounds from the n-hexane extract of *Euphorbia hirta*, Revista de la Sociedad Química de Mexico, 43, 1999, 103–105.

45. Deepti A, Krishna R, Bijjemb V, Ajudhia NK, Bronchospasm potentiating effect of methanolic extract of *Ficus religiosa* fruits in guinea pigs, Journal of Ethnopharmacology, 133, 2011, 324–328.

46. Young WJ, Ji YL, Chang JK, Anti-asthmatic activity of phenolic compounds from the roots of *Gastrodia elata* BI, International Immunopharmacology, 10(2), 2010, 147-154.

47. Pyo MK, Jin JL, Koo YK, Yun-Choi HS, Phenolic and furan type compounds isolated from *Gastrodia elata* and their anti-platelet effects, Archives of Pharmacal Research, 27(4), 2004, 381-385.

48. Panda T, Preliminary Study of Ethno-Medicinal Plants Used to Cure Different Diseases in Coastal District of Orissa, India, British Journal of Pharmacology and Toxicology, 1(2), 2010, 67-71.

49. Kohei K, Yasuhisa S, Takao H, Yasuo F, Hanani E, Mansur U, Toshiko S, Flavonoid glucuronides from *Helicteres isora*, Phytochemistry, 57(2), 2001, 297-301.

50. Anita M, Babita A, Investigation into the mechanism of action *Moringa oleifera* for its anti asthmatic activity, Oriental Pharmacy and Experimental Medicine, 8(1), 2008, 24-31.

51. Babita A, Anita M, Antiasthmatic activity of *Moringa Oleifera* Lam: A clinical Study, Indian Journal of Pharmacology, 40(1), 2008, 28-31.

52. Oluduro OA, Aderiye BI, Connolly JD, Akintayo ET, Famurewa O, Characterization and antimicrobial activity of 4-(β-D-glucopyranosyl-1→4-α-L-rhamnopyranosyloxy)-benzyl thiocarboxamide, a novel bioactive compound from Moringa oleifera seed extract, Folia Microbiol (Praha), 55(5), 2010, 422-426.

53. Gajendra PC, Mast cell stabilizing activity of *Ocimum sanctum* leaves, International Journal of Pharma and Bioscience, 2, 2010, 1-11.

54. Kelm MA, Nair MG, Strasburg GM, DeWitt DL, Antioxidant and cyclooxygenase inhibitory phenolic compounds from *Ocimum sanctum* Linn, Phytomedicine, 7(1), 2000, 7-13.

55. Mizanur RS, Zinnat AM M, Amzad HM, Isolation and characterization of β-sitosterol-D-glycoside from petroleum extract of the leaves of *Ocimum sanctum* L, Asian Journal of Food and Agro-Industry, 2(01), 2009, 39-43.

56. Dinesh L, *Ocimum sanctum* (Tulsi): A Potent Medicinal Herb, Webmed central, 1(11), 2010.

57. Gerda F, Natalie N, Vinesh M, Schalk VR, Nial H, Rudzani N, Investigation of *in vitro* and *in vivo* anti-asthmatic properties of *Siphonochilus aethiopicus*, Journal of Ethnopharmocology, 133, 2011, 843-849.

58. Carmen AL, William ECI, Tracy S, Peter JS, The bioactivity of novel furanoterpenoids isolated from *Siphonochilus aethiopicus,* Journal of Ethnopharmacology, 121(1), 2009, 92-97.

59. Tayade PM, Ghaisas MM, Jagtap SA, Dongre SH, Anti-asthmatic activity of methanolic extract of leaves of *Tamarindus Indica* Linn, Journal of Pharmacy Research, 2(5), 2009, 944-947.

60. Patel PK, Patel KV, Gandhi TR, Evaluation of effect of *Taxus baccata* leaves extract on Bronchoconstriction and Bronchial Hyperreactivity in experimental animal, Global Journal of Pharmacology, 3(3), 2009, 141-148.

61. Pirali-Hamedani M, Hadjiakhoondi A, Rezazadeh SH, Dowlatabadi R, Amini M, Verdian-Rizi MR, Taxezopidine G and 10-deacetylTaxezopidine G from *Taxus baccata* growing in Iran, Chemistry of Natural Compounds, 42(4), 2006, 394-396.

62. Erdemoglu N, Sahin E, Sener B, Ide S, Structural and spectroscopic characteristics of two lignans from *Taxus baccata L,* Journal of Molecular Structure, 692(1-3), 2004, 57-62.

63. Saxena M, Faridi U, Mishra R, Gupta MM, Darokar MP, Srivastava SK, Cytotoxic agents from *Terminalia arjuna*, Planta Medica, 73(14), 2007, 1486-1490.

64. Alam MS, Kaur G, Ali A, Hamid H, Ali M, Athar M, Two new bioactive oleanane triterpene glycosides from *Terminalia arjuna*, Natural Product Research, 22(14), 2008, 1279-1288.

65. Lee MY, Yuk JE, Kwon OK, Kim HS, Oh SR, Lee HK, Ahn KS, Anti-inflammatory and anti-asthmatic effects of *Viola mandshurica* W, Becker, (VM) ethanolic (EtOH) extract on airway inflammation in a mouse model of allergic asthma, J, Ethnopharmacol, 127, 2010, 159–164.

66. Lee JY, Lee JG, Sim SS, Whang WK, Kim CJ, Anti-asthmatic effects of phenylpropanoid glycosides from *Clerodendron trichotomum* leaves and Rumex gmelini herbes in conscious guinea-pigs challenged with aerosolized ovalbumin, Phytomedicine, 18, 2011, 134–142.

67. Abraham YM, Audrey SB, Theophilus CF, Investigation of the bronchodilator activity of *Abrus precatorius*, International Journal of Pharmaceutical Sciences Review & Research, 6(2), 2011, 9-13.

68. Anam E M, Anti-inflammatory activity of compounds isolated from the aerial parts of *Abrus precatorius* (Fabaceae), Phytomedicine, 8(1), 2001, 24–27.

69. Surendra A, Pusapati Madan R, Sankaranarayan Harish M, Antiasthmatic Activity of aqueous extract of *Pistacia integerrima* Galls, International Journal of Pharmacy and Pharmaceutical Sciences, 5(2), 2013, 116-121.

70. Tejas P, Samir S, Anti asthmatic activity of aqueous extract of Myrica nagi bark, Journal of Current Pharmaceutical Research 10(1), 2012, 34-39.

71. Bhatt S, Upadhyay U, Upadhyay S, Soni H, Patel P, Evaluation of acute toxicity study and anti-asthmatic activity of Zeal Herbal granules, Int, Res, J Pharm, 4(5), 2013, 213-215.

72. Ignacimuthu S, Ayyanar M, Sankara Sivaraman K, Ethnobotanical investigations among tribes in Madurai District of Tamil Nadu (India), Journal of Ethnobiology and Ethnomedicine, 2, 2006, 25.

73. Savithramma N, Sulochana CH, Rao KN, Ethnobotanical survey of plants used to treat asthma in Andhra Pradesh, India, Journal of Ethnopharmacology, 113(1), 2007, 54-61.

74. Patil GG, Mali PY, Bhadane VV, Folk remedies used against respiratory disorders in Jalgaon District, Maharastra, Natural Product Research, 7(4), 2008, 354-358.

75. Emmanuel N, Ethno-medico-Botanical survey of medicinal plants used in the treatment of asthma in the Nkongsamba region, Camaroon, Indian Journal of Traditional Knowledge, 9(3), 2010, 491-495.

76. Ralph EH, William TM, William JK, Mechanism For The Emetic Side Effect Of Xanthine Bronchodilators, Life Sciences, 46, 1990, 563-568.

77. Korsgaard J, Ledet M, Potential side effects in patients treated with inhaled corticosteroids and long-acting b2-agonists, Respir Med, 103, 2009, 566-573.

78. Toogood JH, Side effects of inhaled corticosteroids Original Research Article, J Allergy Clin, Immunol, 102(5), 1998, 705-713.

Source of Support: Nil, **Conflict of Interest:** None.