8. SUMMARY, CONCLUSION AND FUTURE PROSPECTS

Introduction:
Indian population still mainly depends on herbal medicinal system for relief. With such a huge section of ever increasing population relying on herbal remedies, it is imperative that the plant products which have been in use be scientifically supported for their efficacy. The main limitation is the lack of standardization of raw materials, of processing methods and of the final products, dosage formulation, and the non-existence of criteria for quality control. Research has to be redirected to the use of modern scientific methodology and techniques to standardize all these different steps and for quality control.

With this in view detailed scientific study was undertaken on plant *Clerodendrum splendens* to validate its pharmacognostic profile, chemical constituent, anti-asthmatics and anti-inflammatory potential of plant.

Introduction to plant *Clerodendrum splendens*:
*Clerodendrum splendens* (Flaming glory bower) is a species of genus *Clerodendrum* belonging to family Verbenaceae.

**Synonym**
Bharangi, Angaravallari, Phanjika, Yashti.

**Taxonomic classification**
Kingdom: Plantae
Family: Lamiaceae / Verbenaceae
Genus: *Clerodendrum*
Species: *splendens*

**Distribution**
The genus *Clerodendrum* [Family Laminaceae (Verbenaceae)] is widely spread in the tropical and subtropical regions of the world, with most of the species occurring in tropical Africa and Asia. The first description of the genus was given by Linnaeus in 1753, with the identification of *C.* infortunatum. *Clerodendrum* genus has more than 500 species and compromises from herbs to small tree (Moldenke 1985; Rueda 1993).
**Botanic Description of Clerodendrum splendens**
Clerodendrum splendens also known as the Flaming glory bower is a woody or semi-woody evergreen vine which grows to about 3.7 m long and climbs by twining. It has ovate to oblong lustrous dark green leaves which are arranged in opposite pairs (Huxley, 1992). The flowers are salverform (tuba shaped) with a slender tube and an abruptly expanded corolla. They are with red flowers, of persistent calyx produced in profusion at the tip of the vine.

**Ethno medicinal claims**
The leaves, roots and stem extracts of *Clerodendrum splendens* are used extensively in traditional medicine for treating many diseases in African folklores. *Clerodendrum splendens* is used for hemorrhoids, sinus disease, menstrual troubles, diarrhea, healing scars, and as a febrifuge and vermifuge agent. The leaves and stem are also used to treat scrofulous infection. Decoction in water (boiling) is the most common mode of preparation. Many plant species in the genus *Clerodendrum* have been used majorly in the treatment of disorders like asthma and inflammation. Various literature reviews for biological activities of these species are associated with chemical constituents present in species (Shrivastava and Patel, 2007). *Clerodendrum* genus are rich source of phenolic, flavonoid, diterpenoid and steroidal compounds hence plant extracts are traditionally reported to be used for remedial purpose in asthma, inflammatory, cancer, diabetes and malaria.

**Phytoconstituents from Clerodendrum splendens**
Steroidal compounds like 24β-ethylcholest-a-5,22,25-triene-3-β-ol, clerosterol and cycloartenol have been isolated from leaves of *C. splendens* (Pinto et al., 1985). β-amyrin and clerodolone have been isolated from the aerial parts of the plant (Joshi et al., 1985). The flavonoids apigenin and hispudilin including it glycoside have been isolated from the leaf extract of the plant (Shrivastava and Patel, 2007).

**Pharmacological Activities of Clerodendrum splendens**
Kouakou et al. (2013) have reported on immunomodulatory activity of polysaccharide isolated from leaves of *C. splendens*. Gbedema et al. (2010) have reported on the antimicrobial and wound healing activities of the leaves of *C. splendens*. A methanolic
extract exhibited MIC ranging from 64 to 256 μg/ml against the wild type organisms. The plant extract also significantly promoted in vivo wound healing and wound contraction (69.2%) in 7 days as compared to the control (46.2%) and nitrofurazone (67.5%) when 100 mg of a 33.3% w/w ointment of C. splendens was applied 500 mm² area to an excision wound on Male Sprague- Dawley rats.

The brief review reveals Clerodendrum splendens has not been comprehensively researched in terms of pharmacognostic, phytochemistry and pharmacological activities. Further, no scientific work is yet reported on Clerodendrum splendens plant regarding its pharmacognostic profile helpful in developing standards for quality, purity, identification along with chemical constituent & anti-asthmatics, anti-inflammatory potential.

AIM AND OBJECTIVES:

1. To study the pharmacognostic parameters of plant part to enable their identification and authentication.
2. To investigate the biological activity based on ethnomedicinal information.
3. To isolate & purify phytoconstituents from extracts of stem, leaves and flower.
4. To characterize the isolated phytoconstituents by advanced analytical techniques like UV/VIS Spectrophotometer, FTIR, HNMR, CHNO and LCMS.
5. Standardization of marketed Ayurvedic formulation for the marker compound present in active plant extract, quantification by HPTLC.
6. Design of suitable Drug delivery system for active isolated compound.

Pharmacognostic study:

Collection and authentication of the plant

Plant parts of Clerodendrum splendens was collected from Nashik district of Maharashtra in February 2011 and later on authenticated by Botanical Survey of India, Pune, where herbarium voucher specimen No. SBP-1 has been deposited.

Pharmacognostic study of Leaves, stem and flower of Clerodendrum splendens

The macroscopy and microscopy of the plant leaves, stem and flowers were studied according to the methods of Brain and Turner, 1975. For microscopic study, transverse sections were prepared and were stained. Powder microscopy for leaves was performed according to the methods of Kokate (1994), Khandelwal (2007).
Physiochemical analysis
Physiochemical values such as the foreign organic matter, moisture content, ash values and extractive values were determined according to the official methods (Anonymous, 1996; Anonymous, 1996) and as per WHO guidelines on quality control methods for medicinal plant materials (WHO, 1998; WHO, 1992). Different extractive values like water soluble and alcohol soluble extractive values were performed by standard method (Anonymous, 1996).

Preliminary phytochemical screening:
Extraction methodology
The leaves, stem and flowers of Clerodendrum splendens were collected from Nashik district and was air dried in shade avoiding exposure to direct sunlight, then were pulverized in grinder. Dried and powdered leaves, stem and flower of C. splendens were extracted successively with various solvents using soxhlet extraction. Different solvents in their sequence of increasing polarity were used for extraction.

1. Leaves: Petroleum ether (60°-80°C), Chloroform, Ethyl acetate, Methanol, Water.
2. Stem: Petroleum ether (60°-80°C), Chloroform, Methanol.
3. Flowers: Petroleum ether (60°-80°C), Methanol.

Preliminary phytochemical screening of various extracts was carried out using the standard procedures (Khandelwal, 2007; Kokate, 1994).

Isolation of phytoconstituents from extracts
Thin Layer chromatography of extracts of leaves, stem and flowers were performed to develop methods for chromatographic separation of phytoconstituents and also to preliminary characterize each separable phytoconstituents from respective extract. Petroleum ether extract of leaves, stem and flower of C. splendens was subjected to saponification by using a standard procedure to gives the unsaponifiable matter, from which different compounds were isolated. Ethyl acetate extract of leaves based on phytochemical and TLC study was processed to isolate flavonoid compounds. While methanol extract of flower was treated with solvent ether and ethyl acetate. From ethyl acetate fraction phytoconstituents were isolated by column chromatography.
Characterization of isolated compound by Spectroscopic study
Spectral characterization of isolated compounds was performed using UV, IR, NMR, and LC-MS. Elemental Analysis was also performed on five numbers of isolated compounds.

Quantitative analysis of isolated compound from Ethyl acetate extract of Leaves, Petroleum ether extract of Stem and standardization of Ayurvedic formulation
Quantitative estimation of isolated flavonoid compounds from leaves and isolated compounds from petroleum ether extract of stem of plant was performed by HPTLC. Characterized flavonoid compounds were also used as marker for quantitative phytochemical evaluation of these compounds in Ayurvedic formulation-Agastya Haritaki Rasayana.

Pharmacological Screening:
Acute toxicity study of all extracts of Clerodendrum splendens were performed in adult albino mice of either sex. All the mice were observed for 72 hr and the LD50 was calculated (Turner, 1971; Harish et al., 2001).

Anti-asthmatic screening
Asthma, the atopic disease with the greatest clinical and economic effect is an allergic and inflammatory outward sign of respiratory disorders. It is essentially characterized by the restriction of tracheal muscle obstruction. The syndrome of bronchial asthma is characterized by wide spread narrowing of the bronchial tree due to contraction of the smooth muscle in response to multiple stimuli resulting in the release of chemical mediators such as Histamine. Thus, study was designed to evaluate the anti-asthmatic activity of Clerodendrum splendens extracts using various experimental animal models. In-vivo models like histamine induced bronchospasm in guinea pigs (Stephen et. al., 2012; Saxena, 2014) and In-vitro model like studies on smooth muscle preparation of guinea pig ileum (Paranajape and Mehta, 2008; Bhujbal et. al., 2009) were used for evaluating Anti-asthmatic activity of the plant.

Anti-cataleptic activity
Catalepsy is a condition in which the animal maintains imposed posture for long time before regaining normal posture. Catalepsy is a sign of extra-pyramidal effect of drugs
that inhibit dopaminergic transmission or increase histamine release in brain. *C. splendens* is used for the treatment of asthma in folk medicine hence it was our objective to study the effect its stem, leaves and flower extracts scientifically on clonidine-induced catalepsy (Kirtikar and Basu, 1988). Since catalepsy is a common extra-pyramidal side effect of neuroleptic agents and the effect of the plant on haloperidol-induced catalepsy is not known, we also studied their effect on haloperidol-induced catalepsy in mice.

Clonidine-Induced catalepsy (Ferre et al., 1990; Nirmal et al., 2011).
Haloperidol-Induced catalepsy (Ferre et al., 1990; Nirmal et al., 2011).

**Anti-inflammatory and analgesic activity**

Ethnomedicinal information suggests that *Clerodendrum* are traditionally used as anti-inflammatory. Inflammation of lungs and airways is one of the symptoms in asthma. Anti-inflammatory and analgesic drugs play an significant role in the treatment of asthma by providing relief from the inflammation and pain of the airways. Hence, objective was to check the analgesic and anti-inflammatory potential of plant.

**Analgesic activity**

Hot Pate test (Woolfe and MacDonald, 1944; Nirmal et al., 2012)
Acetic acid-Induced Writhing test (Koster et al., 1959; Nirmal et al., 2012).

**Anti-inflammatory activity**

Carrageenan-Induced hind paw edema method (Winter et al., 1962; Nirmal et al., 2012)

**Drug Delivery System of active isolated compound:**

Flavonoids are polyphenolic compounds with multiple chemical and biological actions, having potential beneficial effects on health. Quercetin is of particular interest because of its significant quantity present in human foods. Quercetin is having a good permeability but poor water solubility. Quercetin when delivered orally shows poor absorption (<2%) and gastrointestinal metabolism (Gaon et. al., 2009).

Different delivery systems are reported such as nanoparticles, solid lipid nanoparticles, liposomes etc. for the quercetin for various applications such as in neurodegenerative disease, aging etc (Vicentini et al., 2008). Drug delivery system for quercetin in PLGA polymer to deliver drugs for prolonged periods was studied. New HPLC analytical
method for in vitro and In-vivo analysis of quercetin was developed, manufactured quercetin micro particle were characterized for % drug entrapment, particle size, morphology study using SEM and In-vitro release in acetate buffer, Bioaasement of quercetin microsphere were conducted for single dose Pk study in Sprague Dawley rats for period of 28 days.

**Result and Discussion:**

**Pharmacognostic study of Leaves**
The morphology study reveals that leaves are opposite, simple, 6–12 cm long and 2–6.5 cm broad, with an entire margin. Dark green colored from inner side and pale green colored from outside. Texture is smooth. Leaf is petiolate. Transverse section of the leaves showed that the midrib is more or less circular in the sectional profile with flat adaxial side and thick circular abaxial part. The vascular tissues constitute a complex system of hollow wide cylinder of unequal thickness. The vascular bundles in the other regions of the cylinder are wedge shaped and collateral having a group of diffusely distributed xylem elements mixed with narrow fibres. The phloem units occur on the outer end of each xylem strand. The entire cylinder of vascular bundles contains a thin layer of fibres and elongated prismatic calcium oxalate crystals are sparsely distributed in the central ground tissue. The lamina is distinctly dorsiventral, the adaxial and abaxial sides are heteromorphic. Short stalked peltate type of glandular trichomes is located in shallow epidermal pits. Powder preparation of leaves showed adaxial epidermal layer, anomocytic type stomata have circular guard cells and the elliptical stomatal pore. Vein islet and vein termination are seen. Grandular and non-grandular trichomes are seen in surface view.

**Pharmacognostic study of Stem**
The morphology study reveals that stem of *Clerodendrum splendens* is hollow cylindrical having dark greenish surface with characteristic mushy odor. The stem is about 2 mm thick.

Microscopic study shows that stem is a hollow cylinder with even outline. Calcium oxalate crystals of prismatic type are located in cortical sclerenchyma elements and phloem rays are the diagnostic feature of the stem.
Pharmacognostic study of Flowers

Morphological study reveals that flower is pentamerous with 5 free sepals, 5 gamopetalous corolla and five free petal lobes. The stamens are five, incurved within the corolla tube and become exerted when the corolla tube is open.

Microscopic study of flowers shows that sepals are thick with blunt margins and are concave on the abaxial side and glandular trichomes are frequently seen on the inner epidermis. There are five petal lobes which are imbricate and aestivation and these are thicker in the middle and gradually tapering towards margins. The anther is dithecous and four chambered and the anther dehisces longitudinally through the stomium. The pollen grains are circular and have slightly echinate exine and thin smooth infine. The basal part of the petal forms a tubular structure. Fairly prominent circular vascular strands are located along the median part of the corolla tube.

Physiochemical standards

Foreign organic matter of leaves, stem and flower of *C. splendens* was found to 0.25, 0.56 and 0.314% w/w, respectively. Moisture content of leaves, stem and flowers of *C. splendens* is found to 5.63, 6.81 and 4.90% w/w, respectively. Total ash value of leaves, stem and flowers of *C. splendens* is found to 6.79, 7.28 and 5.83% w/w, respectively. Water soluble ash value of leaves, stem and flowers was found to be 0.1, 0.40 and 0.94% w/w, respectively. Acid insoluble ash value of leaves, stem and flowers was found to be 0.21, 0.47 and 0.20% w/w, respectively. Water soluble extractive value of stem, leaves and flowers was found to be 7.8, 13.7 and 7.5 % w/w, respectively. Alcohol soluble extractive value of leaves, stem and flowers was found to be 8.61, 12.1 and 9.0 % w/w, respectively.

Preliminary phytochemical screening

Steroids and triterpenes were present in petroleum ether of leaves, stem and flower; while were also found present in chloroform extract of leaves and stem. Methanolic extract of leaves, stem and flowers mainly revealed presence of flavonoids and tannins. Ethyl acetate extract of leaves revealed presence of alkaloids and flavonoids; while tannins, glycosides, carbohydrates and flavonoids were present in aqueous extract of leaves.
Isolation of phytoconstituents from extracts:
Thin layer chromatography fingerprinting was done for all the extracts in optimized mobile phase and constituents were detected with suitable reagent. From unsaponifiable matter of petroleum ether extract of stem four compounds (PS-1, PS-2, PS-3 and PS-4) were isolated; these were identified sterol and terpene type of compound by spectroscopy analysis.
From unsaponifiable matter of petroleum ether extract of leaves two compounds (PL-1 and PL-2) were isolated; these were identified as sterol and terpene type of compound by spectroscopy analysis. Ethyl acetate extract gives two compounds (EAL-1 and EAL-2), identified as flavonoid by spectroscopic study.
From unsaponifiable matter of petroleum ether extract of flower one compound (PF1) was isolated; identified as sterol and ethyl acetate fraction of methanolic extract of flower yielded one compound (MF1); identified as flavonoid by spectroscopy studies.

Characterization of isolated compound by Spectroscopic study
The isolated compounds such as PS-1, PS-2, PS-3 and PS-4 were identified as 1-(3,5-dimethyl phenyl) penta-3,5-diol, Stigmasterol, Lupeol and β-sitosterol respectively on the basis of their UV, FTIR, GC-MS, LC-MS and NMR data, while the compounds PL-1 and PL-2 and were detected as β-sitosterol and β-carotene. PF-1 was also identified as β-sitosterol based on U.V, Co-FTIR, LC-MS and NMR data.
Compounds EAL-1, EAL-2 and MF1 were identified as Quercetin, Apigenin and Kaempferol respectively on the basis of their UV, FTIR, GC-MS and NMR data. Elemental analysis were also performed on these isolated flavonoid compounds.

Quantitative analysis of isolated compound from Ethyl acetate extract of Leaves, Petroleum ether extract of Stem and standardization of Ayurvedic formulation.
Percentage content of isolated constituents from ethyl acetate extract of leaves was found as EAL-1 = 0.178% w/w and EAL-2 = 0.0155 % w/w.
Percentage content of isolated constituents from petroleum ether extract of stem was found as PS-1 = 2.31% w/w, PS-2 = 0.050% w/w, PS-3 = 0.082 % w/w and PS-4 = 0.217% w/w.
Marker compound quercetin (EAL-1) and Apigenin (EAL-2) was found present in the Ayurvedic formulation- *Agastya Haritaki Rasayana* as determined by HPTLC chromatogram.

Quantification of percent content of marker compound in Ayurvedic formulation are Quercetin = 0.44% w/w and Apigenin = 0.0048% w/w.

*Agastya Haritaki Rasayana* was standardized for presence of Quercetin and Apigenin compounds.

**Pharmacological screening for Anti-asthmatic activity**

Acute toxicity study of all the extracts were studied in Swiss albino mice. LD50 value for all the extracts was found to be more than 1300 mg/kg body weight. There was no mortality at 1000, 1200 and 1300 mg/kg doses, however at these doses animals were having low locomotor activity and looked fatigue. Based on the result of preliminary toxicity testing and published literature on *Clerodendrum* genus the dose of 50 and 100 mg/kg p.o. were chosen for In-vivo histamine aerosol induced bronchoconstriction in Guinea pigs studies.

Various extracts of *Clerodendrum splendens* were screened for anti-asthmatic activity by different screening models. Smooth muscle relaxant study of extracts on smooth muscle preparation of guinea pig ileum (in vitro) was done. Histamine was used to produce contraction of smooth muscle of ileum of Guinea pigs and ability of plant extracts to inhibit smooth muscle contraction was measured. The results of guinea pig ileum indicated ethyl acetate extract of leaves and petroleum ether extract of stem of *C. splendens* (80 μg/ml) significantly inhibited the histamine induced contraction of isolated guinea-pig ileum preparation indicating its H1 receptor antagonistic activity and involvement of β2-agonists on the relaxation of the tissue. The ability of the ethyl acetate extract of leaves and petroleum ether extract of stem to inhibit the contraction induced by the bronchoconstrictor histamine suggests a possible role in the treatment of asthma and supports the anti-asthmatic properties of the plant.

To assess direct anti-histaminic activity of plant extract. The In-vivo model for Histamine induced bronchospasm in Guinea pig was done. Bronchoconstriction induced by Histamine is an immunological model of antigen induced airway obstruction. Histamine
when inhaled causes hypoxia and leads to spasm in Guinea pigs and causes very strong smooth muscle contraction and capillary dilation in cardiovascular system. Bronchodilators can delay the occurrence of these symptoms. The study result indicated ethyl acetate extract of leaves and petroleum ether extract of stem of *C. splendens* expressively extended the latent period of spams followed by exposing to histamine aerosol at the dose of 50 mg/kg and 100 mg/kg, p.o. which showed extreme protection of 65.80%, 67.18% and 58.82% and 59.31% at the time 4 hour as compared to Chlorpheniramine maleate (standard) 1 mg/kg, i.p. which undertaken maximum protection of 75.46% at time 4 hours. The results of the study thus confirmed the bronchodilator properties of the plant, justifying its traditional claim in the treatment of asthma. Drugs effective in the asthma are mostly steroidal in nature (Bouic, 1999). Phytochemical profile of the *C. splendens* plant reveals the presence of steroid, terpenoids and various flavonoids compounds.

Anti-cataleptic activity was screened by studying effect of extracts on clonidine induced catalepsy at 50 mg/kg, i.p. Ethyl acetate extract of leaves and petroleum ether extract of stem of *C. splendens* inhibited Clonidine-Induced Catalepsy significantly. Activity of extracts was compared with standard drug pheniramine maleate (10 mg/kg, i.p.). Involvement of dopamine was studied by checking effect of extracts on Haloperidol Induced Catalepsy. None of the extracts of leaves, stem and flower of *C. splendens* inhibited Haloperidol Induced Catalepsy significantly. This proves that anti-cataleptic effect of ethyl acetate extract of leaves is through inhibition of histamine and not through inhibition of dopamine. It can be concluded constituents present in ethyl acetate extract of the leaves of *C. splendens* may be useful as anti-histaminic and may be used in the treatment of asthma.

Analgesic activity was assessed by Hot Plate Test and Acetic acid-Induced Writhing Test. Ethyl acetate extract of leaves showed significant increase in reaction time as compared to control and other extracts in hot plate test. It showed promising activity comparable to the standard drug pentazocine (10 mg/kg, i.p.) an opioid analgesic whose analgesic activity is mediated through central route. The analgesic effect of opioids arise from their ability to directly inhibit the ascending transmission of nociceptive information.
from the spinal cord dorsal horn and to activate pain control circuits that descends from the mid brain via the rostral ventromedial medulla to the spinal cord dorsal horn.

Peripheral nociceptive activity was evaluated using Acetic acid-Induced Writhing Test. The abdominal constriction produced after administration of acetic acid is related to sensitization of nociceptors to prostaglandins. Ethyl acetate extract of leaves produced significant inhibition of writhing reaction induced by acetic acid compared to control group. It is, therefore, postulated that ethyl acetate extract (50 mg/kg, i.p.) of leaves of *Clerodendrum splendens* may probably exert its analgesic effect by either inhibiting the enzymatic synthesis of prostanoids or by inhibiting the non-enzymatic free radical based synthesis of isoprostanes.

Antiinflammatory activity was studied by using Carrageenan-Induced hind paw edema method in Wistar rats. Ethyl acetate extract of leaf and Petroleum ether extracts of leaf, stem and flower of *C. splendens* produced significant inhibition of paw edema as compared to the control. Anti-inflammatory activity is a desirable property of an antiasthmatic agent as asthma is a chronic inflammatory disease of airways. This proposed mechanism is consistent with previous findings that anti-inflammatory plant principles have shown to act through control of adrenocorticoid hormone and immunosuppression, respectively. Thus ethyl acetate extract of leaf and petroleum ether extracts of leaf, stem and flower of *C. splendens* this extract having anti-inflammatory property will be useful in treatment of asthma.

**Drug delivery system of active isolated compound**

The new HPLC method was developed for quantitative estimation of quercetin in *vitro* and *in vivo* sample were found to be specific, accurate, reliable, and reproducible. The quercetin loaded microsphere on characterization study indicates the entrapped quercetin to be stable in PLGA microparticles and there was continuous release of quercetin from microsphere in phosphate buffer at (pH-6.8) through erosion of PLGA. In- vitro release of 87% quercetin at end of 120 hrs (5 days) in buffer was found satisfactory. PK study after single dose subcutaneous administration in Sprague Dawley rats indicates release of quercetin in plasma for a prolonged period of 28 days overcoming its absorption problem through gastrointestinal tract.
Conclusion

The conclusion drawn from the results obtained in this work indicate that *Clerodendrum splendens* species possess significant medicinal class of compounds supporting their ethnomedicinal use. Pharmacognostic result for leaves, stem and flower of plant, concludes in developing standard for quality, purity and sample identification. Phytochemical investigation for various extracts of leaves, stem and flower of plant indicates presence of steroid compounds like β-sitosterol & Stigmasterol, terpenes compounds like Lupeol and also presence of flavonoid compounds like Quercetin, Apigenin and Kaempferol. Apigenin has been previously reported while flavonoids like Quercetin and Kaempferol are been found first time in the plant. As the ethyl acetate extract of *C. splendens* leaves and petroleum ether extract of stem was found to be having prominent anti-histaminic, analgesic and anti-inflammatory properties, it can be concluded to be used in the treatment asthma. The prominent activity of the ethyl acetate extract of leaves can be related to presence of flavonoid compounds, while for petroleum ether extract of stem can be related to presence of sterol and triterpenes.

Future prospects

The present work on Pharmacognostic, Phytochemical and Pharmacological studies of *Clerodendrum splendens* was performed in view to scientifically validate the ethnomedicinal claim of asthmatic activity for plant. Still some future challenges remain to be looked in and are summarized as below

1. With systematic pharmacognostic and phytophamacological study of *C. splendens* plant and pharmacological effect shown in asthmatic condition (In-vitro & In-vivo) validates its therapeutic significance. On the basis of therapeutic effect the plant part can be used in polyherbal formulation as an alternative or adjuvant, which will be helpful in preventing people from side effect of synthetic product and providing them herbal medicine without side effect.

2. The pharmacological screening reveals that ethyl acetate extract of leaves and petroleum ether extract of stem showing significant anti-asthmatic activity,
Phytochemical results indicates that these activities may be due to the presence of flavonoid compounds in leaves and steroid and triterpene compounds. Thus further exploration of these compounds for its specific mode of action needs to be addressed.

3. The roots of *Clerodendrum splendens* also needs to be studied systematically for pharmacognostic, phytochemical and pharmacological effects.