Review on medicinal plants recommended in Siddha literatures for the management of hypertension

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ABSTRACT

Hypertension is the gift of modern life due to change in food habit and reduced physical activities. According to Siddha literatures hypertension is termed as ‘Kurithi azhal noi’. The causative factors, symptoms and medicinal remedies for hypertension were explained detail in the Siddha literature. Drugs for hypertension are many and usually the treatment is life-long. Hence research is going on to find out a suitable & safe drug. Herbal products in this regard are worthy of investigation. Even though several Siddha literatures are available about the usage of various herbals in the management of hypertension in South India, the information are scattered and hence there is a lack of knowledge on their utility. Hence this present article focused on the herbals which are used in Siddha system of medicine to manage hypertension in Tamil Nadu region with scientific evidences. In Siddha system of medicine, more than 60 medicinal plants are used to treat hypertension and prevent/control blood pressure. In this review, important medicinal plants employed in Siddha system of medicine were discussed in detail about their medicinal efficacy, scientific validation and method of administration.

Keywords: Drug, Herbs; Hypertension; Medicine; Siddha.

INTRODUCTION

Hypertension is a common disorder rising in incidence and once it established, treatment is obligatory. The hypertension is called as ‘Rattha pitham’ or ‘kuruthi azhal’ in Tamil Siddha literatures. Name of the disease is separated in three words like Kuruthi + Azhal + Noi, in which kuruthi means blood, azhal (pitham) means fire or heat and noi means disease. This meaning denotes that blood function gets imbalanced due to increased heat. The word Kuruthiazhal is coined due to the reason that high blood pressure is caused by increased pitham. In this disease the internal bio-vital changes of heat damages the blood’s usual function and expels through eye, nose, mouth, anus, sexual holes, urethra and skin. Siddha system has explained the all the diseases based on the vatham, pitham and kapam. Similarly the etiology of blood pressure also depends upon the increase of pitham.

According to Siddha literature ‘Siddha Maruthavam’ by Dr. Kurusamy Mudaliyar (1954), the etiology of blood pressure includes over-exposure to sun light, improper yoga practice, consumption of heat generating foods with sour, hot and salty foods and excessive sexual desire. The major effects of blood pressure include damage of blood’s regular function with the stimulation of vatham due to increase in the pitham level. Appearances of hemorrhage in internal organs like stomach, liver, spleen, lung, urinary bowel, large intestine, small intestine and heart.

Following types of blood pressure were described in Siddha literatures: Vali kurithi azhal noi (blood pressure with gas), Theekurithi azhal noi (blood pressure with heat), Iyak kurithi azhal noi (blood pressure with cold), Vali thee kurithi azhal noi (blood pressure with heat and gas), Vali iyya kurithi azhal noi (blood pressure with heat and cold), Iyyavali kuruthi azhal noi (blood pressure with cold and heat), Iyya azhal kurithi azhal noi (blood pressure with heat) and Mukkutra kurithy azhal noi (blood pressure with gas, heat, and cold).

Symptoms of blood pressure are head heaviness, anorexia (loss of appetite), severe cough, skin dryness and shrinking, excessive secretation of saliva, nausea and blood vomiting, bad odour in mouth, more attraction in sour foods, vomiting after sour food intake, throat pain and mouth ulcer.

The drugs for hypertension are many and usually the treatment is life-long. Hence research is going on to find out a suitable & safe drug. Herbal products in this regard are worthy of investigation. In this context, the herbals, which are practiced in Siddha system of medicine have received more attention.
**PLANT BASED MEDICINES**

**Phyllanthus emblica**

*Phyllanthus emblica* L. (Family: Euphorbiaceae) is commonly known as Indian gooseberry in English and *Nelli* in Tamil (Figure 1). It is a tree with small to medium in size, reaching 8 to 18 m in height, with a crooked trunk and spreading branches. The branchlets are glabrous or finely pubescent, 10–20 cm long, usually deciduous; the leaves are simple, subsessile and closely set along branchlets, light green, resembling pinnate leaves. The flowers are greenish-yellow. The fruit is nearly spherical, light greenish yellow, quite smooth and hard on appearance, with six vertical stripes or furrows. Quercetin, gallic acid and vitamin C are the major chemical compounds reported in this plant.

It has antioxidant properties that could improve blood vessels, heart and urinary tract changes associated with hypertension (Bhatia et al, 2011). Hydroalcoholic lyophilized extract of *P. emblica* control hypertension by modulating the activity of endogenous antioxidants. Hypertension was induced in rats and treated with different doses of *P. emblica* (75, 150 and 300 mg/kg/day) for 5 weeks. *P. emblica* significantly decreased arterial blood pressure and heart rate along with heart and urinary hypertrophy in a dose-dependent fashion as compared to control. Increased lipid peroxidation end products and decreased endogenous antioxidants in serum, cardiac and renal tissues of hypertensive rats were also normalized. Furthermore, this antihypertensive activity of *P. emblica* was linked with elevated levels of serum potassium and decreased level of sodium. Their results display that *P. emblica* reduces oxidative stress, prevents development and progression of hypertension. In *Siddha* system of medicine, 100 g of dry *P. emblica* fruit powder is given with honey twice a day after food (Murugesamuthaliar, 2008).

**Rauvolfia serpentina**

*Rauvolfia serpentina* (L.) Benth. ex Kurz (Family: Apocynaceae) is known as *Sarpakantha* in Tamil. It is an erect perennial shrub with a long, irregularly, nodular, yellowish root stock. Leaves are arranged in whorls of 3, thin, lanceolate, acute, bright green above and pale beneath. Flowers are irregular corymbose cymes, white, often tinged with violet. Fruits are drupe, single or didymous, shining black, the inflorescence with red pedicels and calyx and white corolla. It is an endangered plant, known for its medicinal properties (Figure 1). This plant was found to contain various phytochemicals like reserpin, reserpilene, rescinnamine, rescinnamidine, serpentinine and serpentine. It contains various indole group alkaloids with reserpin most prominent among them. Reserpin is a hypotensive agent that is in great demand for the modern pharmaceutical industries.

Aslam et al. (2015) have investigated the preventive and curative effects of plant mixture containing *Rauvolfia serpentina*. In preventive mode of treatment, rabbits were pretreated with plant mixture while in curative mode, first cardiotoxicity was induced and then treated with plant mixture. Analysis of heart marker enzymes, fat profile and antioxidant enzymes showed that the pre- and post-administration of plant mixture appreciably restored their levels. Histopathological study also deep-rooted the preventive and curative cardioprotective effects of plant mixture. Plant mixture containing *R. serpentine* significantly ameliorated cardiotoxicity by normalizing myocardial biochemical parameters. In *Siddha* system of medicine, *R. serpentine* root powder (500 mg) was given with honey or hot water twice a day after food.

**Rosa centifolia**

*Rosa centifolia* L. belong to the family Rosaceae is called as *Paneer roja* in Tamil (Figure 1). Individual plants are shrubby in appearance, growing to 1.5–2 m tall, with long drooping canes and greyish green pinnate leaves with 5-7 leaflets. The flowers are round and globular, with numerous thin overlapping petals that are highly scented; they are usually pink, less often white to dark red-purple. This plant is traditionally used in treatment of diabetes, conjunctivitis. Citronellol, geraniol and nerol are present in this plant part.

Ishaq et al, (2014) studied the heart strengthening activity of *R. centifolia* flowers. Dried flower extracts of *R. centifolia* was analyzed for cardio-protective activity and compared with digoxin, the lifesaving drug. Isolated frog heart assembly was used for the experiment. From the different extracts, ethanolic extract showed significant heart-protective activity. Hence, the ethanolic extract was further analyzed using thin-layer and column chromatography and the residue was characterized by UV and IR spectroscopy, which concluded that the compound may be a terpenoid derivative. Better cardio-protective activity over digoxin with reduced toxicity is the advantage of *R. centifolia*. In *Siddha* system of medicine, the rose flower petals were soaked in honey and kept under sun light for twelve days with stirring for every day. This product is called as *Roja Gulkhand*, which is given one tea spoon twice a day (Murugesamuthaliar, 2008).

**Nymphaea stellata**

*Nymphaea stellata* L. (Family: Nymphaeaceae) is commonly called as *Thamarai* in Tamil (Figure 1). It is commonly known as Indian blue water lily in English and has different vernacular names in India. It is a perennial aquatic rooting herb, wild / cultivated, generally found in tanks and ponds throughout the warmer parts of India, particularly the Eastern Ghats. For centuries it has been cultivated in Southeast Asia, especially around temples. It is a stout herb from a cone-like tuberous rhizome and bearing small white pithy roots.
The fruit is about 2.5 – 3 cm in diameter, globose, 6.5 cm, glabrous, and contains round, flask-shaped seeds, less than 1 mm in diameter. Nymphaea is the major compound found in this plant.

Anti hyperlipidaemic effect of flower extract of N. stellata was evaluated in alloxan-induced diabetic rats and its effect was compared with the antidiabetic drug, glibenclamide (Rajagopal and Sasi Kala, 2008). Diabetic animals were treated orally with different doses (200, 300 and 400 mg/kg body weight) of flower extract once a day for 30 days and the body weight of each animal was determined. On the 31st day it is observed that the N. stellata flower extract (300 mg/kg) showed more promising results with regard to fasting blood glucose, plasma insulin levels, haemoglobin counts, urine sugar levels, food intake, water intake, urea and protein. Their results put forward that N. stellata flower extract has promising anti hyperlipidaemic effect in alloxan-induced diabetic rats. In traditional Siddha system of medicine, red variety of Nymphaea stellata flower was taken, dried, powdered and used for treatment. About 0.5 g of this powder was served with honey twice a day after food (Murugesamuthaliar, 2008). N. stellata tuber was also used to prepare decoction (20 g of tuber mixed with 400 ml of water and boil it till reduce to 100 ml). White lotus petals also used in dry form by giving 500 mg of powder with honey twice a day after food (Murugesamuthaliar, 2008).

Cuminum cyminum

Cuminum cyminum L. (Family: Apiaceae) is called as cumin in English and Seerakam in Tamil (Figure 1). It is an annual herbaceous plant, with a slender, glabrous, branched stem which is 20–30 cm tall and has a diameter of 3–5 cm. The stem is coloured grey or dark green. The leaves are 5–10 cm long, pinnate or bipinnate, with thread-like leaflets. The flowers are small, white or pink, and borne in umbels. The fruit is a lateral fusiform or ovoid achene 4–5 mm long, containing two mericarps with a single seed. This spice is reported to contain various phytochemicals like cuminaldehyde.

Role of cumin extract in alleviating the oxidative stress has been investigated in rat model by Rama and Soni (2008). Rats were supplemented with cumin extract (0.5%) for two weeks and oxidative stress was induced and the animals were sacrificed 48 h post stress induction period. Several biochemical and pathological changes such as decreased food intake, loss in body weight, increased activities of plasma amino transferases and increased urea levels were observed in disease control group and these parameters were normalized in treated group. In vitro lipid peroxidation in erythrocytes and tissues was remarkably lower in the cumin treated animals. The superoxide dismutase activity was increased whereas the peroxidase and catalase activity were decreased on stress induction but these effects were relatively of lower in treated animals. Thus the present study provided scientific evidence that cumin extract supplementation can help in preventing the oxidative stress. It is the main ingredient in Asai churnam, which is very useful to treat heart diseases and hypertension in Siddha system of medicine (Formulary of Siddha Medicine, 1993).

Allium sativum

Allium sativum L. is commonly called as garlic in English and Poondi in Tamil (Figure 1). A. sativum is a bulbous plant belongs to the family Amaryllidaceae. It grows up to 1.2 m in height and produces hermaphrodite flowers. The leaves are long, narrow and flat. The bulb is of a compound nature, consisting of numerous bulblets grouped together between the membranous scales and enclosed within a whitish skin, which holds them as in a sac. The flowers are placed at the end of a stalk rising direct from the bulb and are whitish, grouped together in a globular head, or umbel, with an enclosing kind of leaf or spathae. Allicin is the major chemical constituent in this plant.

Wang et al., (2015) performed a meta-analysis to investigate garlic’s effect on blood pressure by searching in Ovid Medline, Cochrane Library and PubMed for randomized controlled trials. Seventeen trials were selected and the pooled analysis revealed that garlic intake caused a 3.75-mm Hg reduction in systolic blood pressure and a 3.39-mm Hg reduction in diastolic blood pressure. Meta-analysis of subgroups exhibited a significant reduction in systolic blood pressure in hypertensive but not in normotensive patients. However, no significant reduction in diastolic blood pressure was observed. Significant diastolic blood pressure reduction was shown in hypertensive patients after sensitivity analysis. Hence, the garlic supplements are found to be superior to controls in reducing blood pressure especially in hypertensive patients. In Siddha system of medicine, the garlic paste was mixed with honey in equal quantity and kept under sunlight for five days and 5 g dose was given two times a day before food (Murugesamuthaliar, 2008).

Citrus aurantifolia

Citrus aurantifolia (Christm.) Swingle (Family: Rutaceae) is called as lemon in English and Elumichai in Tamil (Figure 1). It is a species native to India and Southeast Asia. Small tree 4-5 m tall, trunk frequently twisted and branches bearing short and hard spines in the axils. Leaves oblong-ovate, 2.5-9 cm long and 1.5-5 cm wide, leaf base rounded, apex slightly notched, margins slightly crenate. Petioles remarkable winged. Flowers white, 1.5-2.5 cm diameter, fragrant, arranged in axillary inflorescences with 1 to 7 flowers. The lemon fruit was reported to contain phytochemicals like limonene, limettin, citric acid and ascorbic acid.

Boshtam et al., (2013) have evaluated the antioxidant effect of C. aurantifolia juice and peel in rabbits receiving a hypercholesterolemic diet. Forty white New Zea-
land male rabbits were fed with high fat diet for two months. While the first group was considered as the hypercholesterolemic control, groups 2 and 3 received lemon juice (5 ml/day) and dried lime peel powder (1 g/day), respectively. Before and after the study, weight was measured and a fasting blood was taken and analysed for serum lipids and antioxidant activity. The rabbit's aorta and coronary arteries were isolated and observed for the presence of fatty streaks. Comparing to the hypercholesterolemic control group, the plasma total antioxidant capacity was significantly high in rabbits administered with lemon juice and peel. The fatty streaks in coronary arteries and aorta of the lemon treated groups was significantly decreased when compared to control group. Therefore, C. auransifolia peel and juice increase the plasma antioxidant capacity and can thus prevent the development of atherogenesis. The use of lemon juice against hypertension is a common practice in home remedy. The lemon juice control blood pressure, probably due to the presence of polyphenols and vitamin C. In Siddha system, the lemon juice was squeezed, mixed with sugar and boiled till it became syrup form and used in the dosage of 20 ml with 80 ml of water twice daily (Formulary of Siddha Medicines, 1993).

_Tinospora cordifolia_

_Tinospora cordifolia_ (Thunb.) Miers (Family: Menispermaceae) is commonly called as heart leaved moon seed in English and Seenthil kodi in Tamil (Figure 1). It is a large, deciduous, climbing shrub with several elongated twining branches. Leaves simple, alternate, exstipulate, long petiole, roundish, pulvinate, both at the base and apex. Lamina broadly ovate, 10–20 cm long, 7 nervted and deeply cordate at base, membranous, pubescent above, whitish tomentose with a prominent reticulum beneath. Flowers unisexual, small on separate plants and appearing when plant is leafless, greenish yellow on axillary and terminal racemes. Fruits aggregate of 1-3, ovoid smooth drupelets on thick stalk with sub terminal style scars, scarlet or orange coloured. Tinosporin is the major phytochemical present in this plant.

An Ayurvedic polyherbal formulation containing water extract of _Tinospora cordifolia_ was proved to reduce mild to moderate dyslipidaemia in pre-diabetic state (Vishwas and Raj, 2013). A double blind placebo controlled trial was conducted on 100 patients (50 in each group) having mean age of 48 for 6 months to see the effect of polyherbal formulation in pre-diabetic individuals. Cholesterol, high density lipoprotein, triglycerides and blood sugar level were estimated while low density lipoprotein and very low density lipoprotein were calculated by formula before and after treatment. Mean cholesterol before and after treatment (200.04 and 172.09), HDL before and after treatment (44.544 and 47.30), LDL (116.37 and 92.91), triglycerides before and after treatment 160.16) in polyherbal formulation treated group. While in placebo treated group these values were increased from 170.53 to 191.62 for cholesterol before treatment and after treatment. So, due to lipid lowering potential of this plant, it is used in Siddha system of medicine. The decoction from matured stem of this plant (59 ml) is given twice a day (Murugesamudhaliah, 2008).

**Hibiscus rosa-sinensis**

_Hibiscus rosa-sinensis_ L. is called as shoe flower in English and Sembaruthi in Tamil, which belongs to the Malvaceae family (Figure 1). It is a bushy, evergreen shrub or small tree growing 2.5–5 m tall, with glossy leaves and solitary, brilliant red flowers in summer and autumn. The stem is erect, green, cylindrical and branched. The leaf is simple, with alternate phyllotaxy and is petiolate. The leaf shape is ovate, the tip is acute and margin is serrated. The flower is complete (bisexual), actinomorphic, pentameros, hypogynous, and solitary. The medicinal value of this flower has been mentioned in ancient literature as useful in disorders of the heart. This plant was reported to contain kaempferol, quercetin, malvalic acid, cyanidin-3,5-diglucoside and cyanidin-3-sophoroside-5-glucoside.

The cardioprotective effects of _Hibiscus rosa-sinensis_ flower was evaluated by Gauthaman et al, (2006). Dried flower of _H. rosa-sinensis_ was administered to Wistar albino rats in three different doses (125, 250 and 500 mg/kg in 2% carboxy methyl cellulose) 6 days per week for 4 weeks and thereafter the rats were sacrificed for the determination of cardiac endogenous antioxidants. The hearts were subjected to isoproterenol induced myocardial necrosis. There was significant increase in the baseline contents of thiobarbituric acid reactive substances in _H. rosa-sinensis_ treated group. In the 250 mg/kg treated group, there was significant increase in superoxide dismutase, reduced glutathione, and catalase levels. Thus the flower of _H. rosa-sinensis_ (250 mg/kg) protected endogenous antioxidant compounds in rat heart and also prevented the myocardium from isoproterenol induced myocardial injury. In Siddha system of medicine, it is used as the main ingredient of sembaruthi legium, which is given 5 g twice a day to control blood pressure (Kupusamymudhaliah, 2008).

**Terminalia chebula**

_Terminalia chebula_ Retz. (Family: Combretaceae) is called as Ink nut in English and Kadukka i in Tamil (Figure 1). It is a medium deciduous tree growing to 30 m tall. The leaves are alternate, oval, 7–8 cm long, acute tip, cordate at the base, margins entire, glabrous above with a yellowish pubescence below. The yellow flowers are monoecious, borne in terminal spikes. The fruit is drupe-like, 2–4.5 cm long with five longitudinal ridges. The fruits are smooth ellipsoid drupes, orange brown in colour, single angled stone. The chemical constituents
present in this plant are chebulosides, chebulin, chebulinic acid and gallic acid.

The antioxidant role of *Terminalia chebula* aqueous extract was evaluated against age-related oxidative stress in rat heart tissues (Mahesh and Begum, 2007). Young and aged rats were treated with *T. chebula* aqueous extract at a dose of 200 mg/kg body weight orally for 4 weeks. Administration of *T. chebula* to aged rats prevented the depletion of superoxide dismutase, catalase, glutathione peroxidase activities and reduced glutathione, vitamin C and E contents. Also, the level of malondialdehyde was decreased in heart tissues in the *T. chebula* treated group. The results show that *T. chebula* aqueous extract exhibited antioxidant activities and also controls the lipid peroxidation in rat heart tissues. *T. chebula* dried pulp powder (0.5 g) is given with honey twice a day in Siddha medicine (Kuppusamy Mudhaliar, 1987).

**Terminalia bellerica**

*Terminalia bellerica* (Gaertn.) Roxb. (Family: Combretaceae) is called as Beleric myrobalans in English and Thandrikkai in Tamil (Figure 1). It is a large deciduous tree found throughout the Indian forests and plains. Leaves are alternate, broadly elliptic, puberulous when young but glabrous on maturity and the nerves are prominent on both surfaces. Flowers are in axillary, spatler spikes longer than the petioles. Calyx lobes are prominent on both surfaces. Flowers are in axillary, spatler spikes longer than the petioles. Calyx lobes are pubescent outside. The fruits are green and inflated when young and yellowish and shrink when mature with stony nuts. Belleric acid and gallic acid are the major phytochemicals reported in this plant.

Khan and Gilani (2008) investigated the anti-hypertension effect of *T. bellerica* fruit. The crude extract of *T. bellerica* fruit induced a dose-dependent (10-100 mg/kg) fall in the arterial pressure of rats. *T. bellerica* inhibited the rate of atrial contractions in isolated Guinea pig. In rabbit thoracic aorta, *T. bellerica* relaxed the phenylephrine and potassium dependent contractions similar to that of standard drug vera pamil. The vasodilator effect of *T. bellerica* was endothelium-independent. Their results show that *T. bellerica* lowers blood pressure through calcium antagonist mechanism and thus provides a sound mechanical background for its medicinal use in hypertension. The dried pulp powder is given 0.5 g with honey twice a day in Siddha system of medicine (Murugesan Mudhaliar, 2008).

**Cynodon dactylon**

The rhizome of *Cynodon dactylon* (L.) Pers. (English: Barmuda grass, Tamil: Arugampul) which belongs to the family Poaceae is used for the treatment of heart failure in folk medicine (Figure 1). The leaf blades are grey-green in colour and short, usually 2–15 cm long with rough edges. The erect stems are slightly flattened, often tinged purple in colour. The seed heads are produced in a cluster of two to six spikes together at the top of the stem, each spike 2–5 cm long. This plant was found to possess some phytoconstituents like cyanogenic heterosides, cyanogenic glycoside and carotene.

Garjani et al, (2009) investigated the heart contractility of rats administered with hydroalcoholic extract of *C. dactylon* rhizome. Right-heart failure was induced by intraperitoneal injection of monocrotaline (50 mg/kg). Two weeks later, the animals were administered with different doses of the extract for fifteen days and then cardiac functions and myocardial hypertrophy markers were measured. Very low signs of fatigue, peripheral cyanosis and dyspnea and high survival rate were observed in rats treated with *C. dactylon* extract. Administration of *C. dactylon* extract led to profound improvement in cardiac functions as demonstrated by decreased right ventricular end diastolic pressure and elevated mean arterial pressure in rats. The extract reduced heart and lung congestion by decreasing tissue wet/dry weight ratio. In the isolated rat hearts, the extract produced a remarkable positive inotropic effect concomitant with a parallel decrease in left ventricular end diastolic pressure. The results indicated that *C. dactylon* exerted a strong protective effect on right heart failure. In Siddha system, 20 g of *C. dactylon* grass was taken, crushed and 400 ml of water was added, boiled till the volume becomes 100 ml and filtered and then added with boiled milk. It is given at a dose of 50 ml per day at early morning (Murugesan Mudhaliar, 2008).

**Justicia adhatoda**

*Justicia adhatoda* L. (Family: Acanthaceae) is called as Malabar nut in English and *Adathodai* in Tamil (Figure 2). It is a shrub with lance-shaped leaves with 10 to 15 cm in length. They are oppositely arranged, smooth-edged, and borne on short petioles. Trunk has many, long, opposite, ascending branches, where the bark is yellow in color. Flowers are white and the inflorescence shows large, dense, axillary spikes. Fruits are pubescent, and are with club-shaped capsules. Vasicinone, vasicinol and adhatodine are the major chemical compounds in this plant.

Methanol extracts of *J. adhatoda* displayed strong free radical scavenging activity against DPPH radical (Owen and Johns, 2002). This plant extract was further partitioned into a hexane, chloroform, ethyl acetate, and water fractions and examined for their ability to protect oxidation of human low-density lipoprotein (LDL). The hexane fraction displayed three folds higher ability to protect LDL than the standard Trolox. Their results suggested that this medicinal plant may provide a therapeutic benefit towards prevention and treatment of cardiovascular diseases. Squeezed juice from *J. adhatoda* leaves (20 ml) was mixed with 20 ml of honey and given twice a day. Otherwise the decoction was prepared from 20 g of leaf with 400 ml of water and boiled till the volume reduced to 100 ml and then given to the patients (Kuppasamudhaliar, 2008).
Withania somnifera

Withania somnifera (L.) Dunal (Family: Solanaceae) is called as Winter cherry in English and Amukkara kizhangu in Tamil (Figure 2). This species is a short, tender perennial shrub growing 35–75 cm tall. The flowers are small and green. The ripe fruit is orange-red in colour. Withanolides, somniferin and withaferin are the major chemical components in this plant.

The cardioprotective activity of an Indian drug Ashwagandharishta, prepared from W. somnifera as major ingredient was investigated using isoproterenol induced myocardial infarction in rats (Tiwari and Patel, 2012). Wistar albino rats were pretreatment with Ashwagandharishta (2 ml/kg per day) for 30 days and at the end the myocardial infarction was induced. Then, animals were sacrificed, hearts were taken out, weighed and immediately processed for biochemical studies. Pretreatment with Inderal and Ashwagandharishta significantly prevented the adverse changes in the levels of serum marker enzymes as creatine kinase, lactate dehydrogenase, aspartate aminotransferase and alanine aminotransferase and also improved serum lipid profile. Ashwagandharishta pretreated groups showed significantly increased glutathione and reduced malondialdehyde levels. Thus, experimental finding suggested the cardio protective activity of Ashwagandharishta due to an augmentation of endogenous antioxidants and inhibition of lipid peroxidation in heart tissues. In Siddha practice, 500 mg of W. somnifera root powder was given with honey (Murugesamuthalir, 2008).

Nardostachys jatamansi

Nardostachys jatamansi (D.Don) DC. (Family: Caprifoliaceae) is commonly called as Valerina root in English and Sadamani in Tamil (Figure 2). The plant grows to about 1 m in height and has pink, bell-shaped flowers. It is found in the altitude of about 3000–5000 meters. Nardosinonediol and nardosinone are the major phytochemicals present in this plant.

The effect of ethanolic extract of N. jatamansi on the mitochondrial and lysosomal damage induced by doxorubicin in rats was evaluated by Subashini et al., (2007). Heart mitochondria were isolated from rats treated with doxorubicin exhibited depressed rates respiration, low respiratory control ratio, decreased oxidative phosphorylation ratio, adenosine triphosphate content and cytochromes. In addition the doxorubicin given rats showed significant changes in the lysosomal enzymes and membrane bound phosphatases. Also myocardial damage showed loss of myofibrils, mitochondrial swelling, and cytoplasmic vacuolization. Pretreatment with N. jatamansi (500 mg/kg bw orally) for seven days ameliorated the observed abnormalities in rats. These findings suggest that the cardioprotective efficacy of N. jatamansi could be mediated possibly through its antioxidant effect. In traditional system of medicine, 500 mg of N. jatamansi tuber powder was given with honey (Murugesamuthalir, 2008).

Centella asiatica

Centella asiatica (L.) Urban (Family: Apiceae) is called as Indian Pennywort in English and Vallarai in Tamil (Figure 2). The stems are slender, creeping stolens, green to reddish-green in color. The leaves are borne on pericladial petioles, around 2 cm. The rootstock consists of rhizomes, growing vertically down. The flowers are white or pinkish to red in color, born in small umbels. Each flower is partly enclosed in two green bracts. The hermaphrodite flowers are minute in size with 5-6 corolla lobes and bears five stamens and two styles. This plant was found to contain various phytochemicals like centellin, asiaticin and centelicin. Asiatic acid (AA) is a triterpenoid compound extracted from C. asiatica and exhibits a variety of pharmacological effects.

Transforming growth factor-β1 (TGF-β1) signaling has been considered as a trigger contributing to pathological cardiac hypertrophy. Si et al., (2014) evaluated the anti-hypertrophic effects of AA in a TGF-β1-stimulated hypertrophic response. Treatment with AA markedly attenuated the hypertrophic responses of cardiomyocytes as reflected by reduction in the cardiomyocyte surface area and the inhibition of atrial natriuretic peptide mRNA expression. It also blocked the p38 and extracellular signal-regulated kinase phosphorylation and the reduction of nuclear factor-κB binding activity. In vivo experiments indicated that the administration of AA prevented cardiac hypertrophy and dysfunction.
Hence, this study suggests that C. asiatica extract containing AA could be an effective therapeutic agent for cardiac hypertrophy. In traditional Siddha system, 500 mg powder of C. asiatica was given with honey to the hypertensive patients (Murugesamuthaliar, 2008).

**Hygrophila auriculata**

Hygrophila auriculata (K.Schum.) Heine (Family Acanthacnea) is a wild herb commonly known as long leaved barleria in English and Neermulli in Tamil (Figure 2). It is found in moist places throughout India and is one of the main sources of Siddha drug. This plant is a sub shrub, stem is reddish brown and the shoot has 8 leaves and six thorns at each node. The leaves occur in whorls, the outer pair of leaves are larger, lanceolate, minutely dentate and sub sessile. Calyx four lobed, unequal, corolla consists of 5 petals, gamopetalous, unequal, purple coloured, stamens four, in two pair, filaments unequal, anthers divergent, ovary two celled, four ovules in each cell. Asteracanthine, asteracanthicine, lupeol and lupenone are the major chemical constituents in this plant.

The antioxidant potential of hydroalcoholic extract of H. auriculata was studied in terms of DPPH, nitric oxide and hydroxyl radical scavenging activities and ferryl bipyridyl complex scavenging activity along with lipid peroxidation inhibition in rat liver homogenate (Vijayakumar et al, 2005). The extract showed good radical scavenging activity at various concentrations (200–1000 µg/ml) against DPPH, with moderate scavenging activity against nitric oxide, hydroxyl radical, ferryl bipyridyl complex and lipid peroxidation. Thus the H. auriculata extract could be an effective antioxidant and its therapeutic activity against hypertension in Indian system of medicine. In Siddha medicine, H. auriculatus leaf decoction (50 ml) was prescribed twice a day for controlling blood pressure (Murugesamuthaliar, 2008).

**Saccharum officinarum**

Sugar cane (Saccharum officinarum L., Family: Poaceae) is commonly called as Karumbu in Tamil (Figure 2). The stems are purple in colour and can reach 5 m in height. They are jointed, nodes being present at the bases of the alternate leaves. The elongated, linear, green leaves have thick midribs and grow to a length of about 30 to 60 cm. The terminal inflorescence is a panicle, the spikelets are borne on side branches and are about 3 mm long and are concealed in tufts of long, silky hair. The fruits are dry and each one contains a single seed. This plant was reported to contain phytochemicals like naringenin, tricin and apigenin.

Policosanols derived from sugar cane is currently incorporated into dietary supplements for its potential LDL cholesterol minimizing effects. Ogier et al, (2013) conducted a study to investigate the effects of a new dietary supplement containing sugar cane policosanols on LDL-cholesterol. In a double-blind, randomized, parallel controlled study, 39 subjects from 21 to 55 years with moderate hypercholesterolemia without drug treatment were administered policosanols containing dietary supplement over a period of 16weeks. Triglycerides, LDL and total cholesterol were reduced at week 16 in the treated group compared with baseline while other parameters were not changed. Thus daily consumption of dietary supplement with policosanols could decrease LDL and total cholesterol levels and is therefore an interesting, convenient drug to manage mild to moderate hypercholesterolemia. In Siddha medicine, cane sugar is used as vehicle for several drugs. Sugar cane juice is one of the ingredients in Asai chumam, which is used to treat blood pressure in Siddha system of medicine (Formulary of Siddha Medicines, 1993).

**Melothria maderaspatana**

Melothria maderaspatana L. M. Roem. (Family: Cucurbitaceae) is called as Rough bryony in English and Musumusukkai in Tamil (Figure 2). It is a prostrate scabrid herb with simple tendrils. Leaves are 4-8 cm long, ovate-deltoid, angular, 3-lobed, base cordate, margin denticulate and apex acuminate with petiole. Male flowers are born in axillary, sessile clusters. Calyx tube is villous, lobes subulate, erect, petals 5 mm long, ovate-oblong and yellow in colour, stamens 3, free, inserted at the base of calyx tube, anthers oblong and ciliate. Female flowers are solitary or in clusters. Berry type fruit with globose shape and red in colour. Seeds are lenticular and rugose. Methylthiolane, Diazeene and Eugenol are the major chemical components present in this plant.

The antihyperlipidemic effect of crude ethanolic extract of M. maderaspatana leaf in hypertensive rats was investigated (Veeramani et al, 2012). Surgical wound was produced in rats and after one week recovery period, hypertension was induced and then the extract was administered orally once a day for 6 weeks. In hypertensive rats the levels of plasma and tissue total cholesterol, triglycerides, free fatty acids and phospholipids were significantly increased and administration of extract normalized these parameters. Further, the levels of LDL cholesterol and VLDL cholesterol were significantly increased while HDL cholesterol decreased in hypertensive rats and administration of extract brought these parameters to normality which proved their antihyperlipidemic action. Histopathology of liver, kidney and heart showed reduced damages in rats treated with extract. These findings provided evidence that M. maderaspatana leaf extract has antihypertension effect which could attribute to its antihyperlipidemic activities. Whole plant powder is given (0.5 g) with honey twice a day in Siddha system of medicine (Formulary of Siddha Medicines, 1993).

**Solanum trilobatum**

Solanum trilobatum L (Family Solaneaceae; Climbing brinjal in English and Thoothuvelai in Tamil) is a perennial, medicinal herb found in some of the warmer parts...
of India (Figure 2). It is a prickly diffuse, bright green herb, 2–3 m height with branched spiny scandent shrubs. Leaves are deltoid or triangular, irregularly lobed. Flowers are purplish-blue, arranged in cymes. Berry fruits are globose, red or scarlet. Sobatam, β-solamarine, solasodine and solaine are the major chemical constituents present in this plant.

A previous study investigated the effect of *S. trifolatum* on lipid peroxidation in Swiss albino mice (Venkatesan et al., 2008). Lung carcinoma was induced and the treatment was started by the oral administration of *S. trifolatum* (200 mg/kg bw). Enhanced lipid peroxidation was observed in lung, liver and kidney of tumor-bearing animals with a significant decrease in enzymic and non-enzymic antioxidants. Administration of *S. trifolatum* extract significantly decreased the level of lipid peroxidation and enhanced the activity of antioxidant enzymes. Their result suggests that *S. trifolatum* possess strong antioxidant activity that could prevent lipid peroxidation and augmenting defense system. Due the antioxidant property, *S. trifolatum* might exhibit antihypertensive effect. It is one of the main ingredients in *Asai churnam*, which is given 0.5 g twice a day in Siddha system (Formulary of Siddha Medicines, 1993).

**Azadirachta indica**

*Azadirachta indica* A. Juss. is known as Margosa or Neem tree in English and Vembu in Tamil, which belongs to the family Meliaceae (Figure 2). It is a fast-growing tree with 15–20 m height, evergreen, branches are wide and spreading. The opposite, pinnate leaves are 20–40 cm long, and the terminal leaflet is often missing. The petioles are short. The flowers are arranged in drooping axillary panicles. An individual flower is 5–6 mm long, protandrous, bisexual, and male flowers exist on the same individual tree. The fruit is a smooth (glabrous) olive-like drupe. This plant was found to possess some bioactive compounds like Azadirachtin, nimbim and nimbine.

The cardioprotective potential of aqueous leaf extract of *A. indica* was evaluated on the basis of haemodynamic, biochemical and histopathological parameters in isoprenaline induced myocardial infarction in rats (Peer et al., 2008). Their data showed that *A. indica* (250, 500 and 1000 mg/kg, p.o.) significantly restores most of the haemodynamic, biochemical and histopathological parameters. The extract normalizes the arterial blood pressure, systolic arterial blood pressure, diastolic arterial blood pressure, increased heart rate, level of cardiac marker enzymes (Lactate dehydrogenase, and serum glutamate oxaloacetaminase), total cholesterol, triglycerides, and HDL-cholesterol. On histopathological examination, myocardial damage in isoprenaline control group was recovered by extract treatment. Finally it could be concluded that *A. indica* leaf extract exerts anti-hypertension effect and thereby exhibits cardioprotective activity. It is used in Siddha medicine as one of the ingredients of *Asai Churnam* (Formulary of Siddha Medicines, 1993).

**Luecas aspera**

*Luecas aspera* L. belongs to the family Lamiaceae and is called as Thumbe in English and *Thumbai* in Tamil (Figure 2). It is an annual plant that can reach heights of 15–60 cm. The leaves are obtuse, linear or lanceolate, length of 8.0 cm, the epidermis is covered in a thick waxy cuticle and is traversed with stomata. Flowers are white, small, and directly attached to the base without stalk. The flowers are held together in auxiliary whorls or dense terminals. The fruits are 2.5 mm long, brown, smooth and oblong in shape. Phytoconstituents such as oleanolic acid, ursolic acid and apigenin were reported in this plant.

Antioxidant property of *L. aspera* was assessed by phosphomolybdate method and was found to be high in ethanolic extract (Borah et al., 2011). Total phenolic and flavonoid content was found to be 80.249 mg/g dry wt. and 0.927 mg/g dry wt. respectively. Antioxidant vitamins were also estimated and the results revealed high content of vitamin C (0.084 mg/g fresh wt.) and vitamin E (645.69 mg/g fresh wt.). Free radical scavenging activity was measured by several *in vitro* methods. Thus, the study showed the promising antioxidant activity of *L. aspera* which could be a reason for its usage in Siddha system of medicine to control hypertension. It is also one of the ingredients of *Asai Churnam*, which is used in Siddha medicine to treat hypertension (Formulary of Siddha Medicines, 1993).

**Eclipta prostrata**

*Eclipta prostrata* L. is called as trailing eclipta in English and *Karisaalankanni* in Tamil, which belongs to the family Asteraceae (Figure 2). This plant has cylindrical and grayish roots. The solitary flower heads are 6–8 mm in diameter with white florets. The achenes are compressed and narrowly winged. Phytochemicals like ecliptal, ecalbatin and wedelolactone were found to occur in this plant.

Antihypertensive activity of this plant extract was evaluated in male wistar albino rats (Jena et al., 2013). Ethanol extract of *E. prostrata* leaf was administered in 100, 200 & 400 mg/kg doses and systolic, diastolic, mean arterial pressure and heart rate were measured at different intervals. The extract was found to significantly decrease the rise in blood pressure in a dose dependent manner comparable to Quinapril. Thus the reported work provides scientific evidence for the antihypertensive activity of *E. prostrata*. The whole plant powder of *E. prostrata* (500 mg) was given with honey twice a day to control blood pressure (Murugesamudhialar, 2008).
**Piper nigrum**

*Piper nigrum* L. is known as black pepper in English and *Milagu* in Tamil, which belongs to the Piperaceae family (Figure 3). The pepper plant is a perennial woody vine growing up to 4 m in height, rooting readily where trailing stems touch the ground. The leaves are alternate, entire and 5-10 cm long. The flowers are small, produced on pendulous spikes, 4-8 cm long at the leaf nodes. The fruit of the black pepper is drupe type and when dried it becomes peppercorn. This plant was reported to contain Piperine as the major phytochemical.

The effect of *P. nigrum* on the protection of cardiac antioxidant status of atherogenic diet fed hamsters was evaluated by Agbor et al, (2012). Hamsters were fed atherogenic diet supplemented with different doses of *P. nigrum* (1 and 0.25 g/kg) for 12 weeks and the end of the experimental period the heart, liver and kidney were analyzed for lipid profile and antioxidant enzymes activities. Atherogenic diet induced a significant increase in the lipid profile and significantly altered the antioxidant enzyme activities. Supplementation with *P. nigrum* significantly inhibited the alteration effect of atherogenic diet on the lipid profile and antioxidant enzymes activities. Thus *P. nigrum* extracts was proved to possess a protective role against atherogenic diet induced oxidative stress in cardiac tissues. It is one of the ingredients in *Elathi Churnam*, which is given 500 mg twice a day to treat hypertonion in *Siddha* system of medicine (Kuppusamymudhalial, 1987).

**Maranta arundinacea**

*Maranta arundinacea* L. (Family: Marantaceae) is called as Indian Arrow root in English and *Kookai kizhangu* in Tamil (Figure 3). It is a perennial plant growing to about 2 feet height and has small white flowers. The rootstocks are dug when the plant is one year old, and often exceed 30 cm in length and 19 mm in diameter. The tubers are yellowish white, jointed and covered with loose scales. Starch is the major component of arrow root.

The effect of purified starch from *M. arundinacea* on the metabolism of lipid was studied in rats fed with atherogenic diets (Prema et al, 1978). *M. arundinacea* starch caused deposition of low concentration of cholesterol in the tissues including aorta and heart of the rats fed with atherogenic diets. This is explained by increased excretion of fecal sterols and bile salts. The concentration of triglycerides was also generally low in the aorta and heart in rats fed *M. arundinacea*. Based on the observations from the reported work, it could be concluded that the tubers of *M. arundinacea* has antilipidemic effect and therefore exhibits significant role in the prevention of hypertension. It is one of the ingredients of *Elathi Churnam*, which is given 500 mg twice a day to treat hypertonion (Kuppusamymudhalial, 1987).

**Zingiber officinale**

*Zingiber officinale* Roscoe is called as Ginger in English and *Inji* in Tamil, belongs to the family Zingiberaceae (Figure 3). It is a perennial reed-like plant with annual leafy stems, about 3 to 4 feet tall. Traditionally, the rhizome is gathered when the stalk withers and immediately washed and scraped to prevent sprouting. Ginger produces clusters of white and pink flower buds that bloom into yellow flowers. Gingerone, gingiberene and gingerol are the major components present in this plant.

Rohini et al, (2013) studied the protective effect of gingerin experimental cardiac hypertrophy in rats. The treatment with ethanolic extract of *Z. officinale* (200 mg/kg and 400 mg/kg) significantly increased the ratio of left ventricular weight to body weight, left ventricular wall thickness, left ventricular protein content, left ventricular collagen content and left ventricular RNA concentration. The *Z. officinale* extract (400mg/kg) markedly attenuated the left ventricular hypertrophy. These results implicate for the first time the role of *Z. officinale* in pathological cardiac hypertrophy and it also gives scientific validation for its usage as anti-hypertensive agent in *Siddha* system of medicine. It is one of the ingredients of *Elathi Churnam*, which is given 500 mg twice a day to treat hypertension (Kuppusamymudhalial, 1987).

**Smilax china**

*Smilax china* L. (Family: Smilacaceae) is known as China root in English and in Tamil *Parangipattai* (Figure 3). The root of *S. china* is used by the tribals of South India for the treatment of liver diseases. It will grow as shrub, forming dense impenetrable thicket and they will also grow over trees and other plants up to 10 m high, their hooked thorns allowing them to hang onto and scramble over branches. The leaves are heart-shaped and 4–30 cm long. Flowers are dioecious with white green colour. If pollination occurs, the plant will produce a bright red to blue-black spherical berry fruit about 5–10 mm in diameter. This plant is found to contain astilbin and quercetin as the major phytocompounds.

Diao et al, (2014) investigated the anti-myocardial ischemia and reperfusion injury effect of Astilbin, a flavonoid from the rhizome of *S. china* in diabetic rats. The results showed that Astilbin significantly attenuated hypoxia-induced myocardial cell injury in a dose-dependent manner. Treatment of rats with Astilbin by intravenous injection at a single dose of 50 mg/kg protected the rats from myocardial injury as indicated by decreasing infarct volume, improving hemodynamics and reducing myocardial damage, and also lowered serum levels of pro-inflammatory factors. Additionally, treatment of rats with Astilbin at dose of 50 mg/kg for continuous 14 days attenuated cardiac remodeling in the myocardial injury. These protective effects suggested that *S. china* extract containing Astilbin might
prevent the myocardial inflammatory cascade and thus useful in controlling hypertension. In Siddha system of medicine, this plant is used to prepare Parangippattai churnam. The rhizome of this plant was powdered and 500 mg was given with milk (Formulary of Siddha Medicines, 1993).

**Ocimum sanctum**

Ocimum sanctum L. is called as Holy basil in English and Thulasi in Tamil (Figure 3). It is an aromatic plant belonging to the family Lamiaceae which is native to Indian subcontinent and widespread as a cultivated plant throughout the Southeast Asian tropics. The two main morphotypes cultivated in India are green-leaved (Lakshmi tulasi) and purple-leaved (Krishna tulasi). It is an erect, many branched sub-shrub, 30–60 cm tall with hairy stems and simple phyllotaxic green or purple leaves that are strongly aromatic. The flowers are purplish in elongated racemes in close whorls. Phytoconstituents such as ocimene, camphor, carvacrol, eugenol, limonene and apigenin were found to present.

Suanarunsawat et al, (2010) conducted a study to explain the anti-hyperlipidemic effect of O. sanctum leaves in rats fed high fat diet. O. sanctum extracts depressed high serum levels of total cholesterol, triglyceride and LDL-cholesterol whereas no significant effect on HDL-cholesterol was observed. It also suppressed high levels of liver cholesterol and triglyceride with no significant effect on both lipids in feces. In addition, it normalized the high serum levels of lactate dehydrogenase and creatine kinase but no significant effect on high serum levels of alanine transaminase, aspartate aminotransferase, and alkaline phosphatase was obtained. They concluded that treatment with O. sanctum extract during high fat diet fed animals decreased the high serum lipid profile and expressed antihypertensive actions. It is the main ingredient in Parangippattai churnam, which is given 500 mg with milk (Formulary of Siddha Medicines, 1993).

**Piper cubeba**

Piper cubeba L. belongs to the family Piperaceae and is known as tailed pepper in English and Vaalmilagu in Tamil (Figure 3). It consists of the dried berries, similar in appearance to black pepper, but with long stalks. The dried pericarp is wrinkled and its color ranges from greyish-brown to black. The seed is hard, white and oily. It has aromatic and pungent, acrid, slightly bitter and persistent taste. Phytochemicals like piperine, cubebene, cubebin, sabinene, thujene, careen, caryophyllene, and cadinene are reported in this plant.

P. cubeba extract containing cubebin has been evaluated for vasorelaxant effect rats (Carvalho et al, 2013). Endothelium-dependent and -independent relaxation were elicited by (-)-cubebin in intact aortic rings. Dose-response curves were constructed for pre-incubation of vascular rings with (-)-cubebin. (-)-Cubebin was found to exert a vasorelaxant effect irrespective of the presence of endothelium. These results suggest that (-)-cubebin promotes vasorelaxation in rat aorta, without prostacyclin involvement. In Siddha system of medicine, it is the main ingredient in Vilvathi legium, which is given 5 g twice a day (Kuppusamymudaliyar and Uthamarayan, 1998).

**Saussurea lappa**

Saussurea lappa C.B. Clarke is commonly known as Costus root in English and Kottam in Tamil belongs to the family Asteraceae (Figure 3). It is a tall, perennial herb that grows to a height of 1-2 m; stem is upright, stout and fibrous while root is a long stout of approximately 60 cm with a characteristic odour; leaves are lobate, stalked, membranous, irregularly toothed. Flowers are stalkless, dark purple in colour and are arranged in axillary heads. Fruit of S. lappa is cupped, curved, compressed and hairy. This plant contains saussurine, costunolide and lactone as the major phytochemicals.

Mohamed Saleem et al, (2013) studied the cardioprotective effect of aqueous extract of S. lappa root against isoproterenol induced myocardial injury. The rats were pretreated with the aqueous extract of S. lappa in three different doses (100, 200 and 300 mg/kg) through the oral route. Chronic oral administration of S. lappa extract significantly restored the level of myocardial lactate dehydrogenase, creatinine kinase, aspartate transaminase, thioarbituric acid reactive substances and glutathione levels. The extract effect was comparable with that of reference standard α-tocopherol in biochemical and histopathological changes. The overall beneficial effect observed at the dose of 200 mg/kg indicated that S. lappa produced significant dose-dependent activity against myocardial injury and thus can also act against hypertension. In Siddha system of medicine the aqueous extract of the S. lappa root was used to treat angina pectoris. The root powder 250 mg is given with honey to control hypertension in Siddha system of medicine (Murugesamudhalair, 2008).

**Taxus baccata**

Taxus baccata L. (Family: Taxaceae) is called as Yew leaves in English and Talisapathiri in Tamil (Figure 3). It is a small to medium-sized evergreen tree, growing 10–20 m tall, with a trunk up to 2 m diameter. The leaves are flat, dark green, 1–4 cm long, arranged spirally on the stem, but with the leaf bases twisted. The seed cone contains a single seed, which is 4–7 mm long, and partly surrounded by a modified scale called arill. This plant was found to possess various phytochemicals like paclitaxel, taxoid, taxine, taxiresinol and lignins.

Taxine, the active principle of leaves of T. baccata was investigated in isolated aorta of rabbit for the calcium channel antagonistic effect (Tekol and Gogusten,
Taxine inhibited concentration-dependently the calcium-induced contractions of the aorta. Taxine relaxed the aorta, which was precontracted by 60 mmol/L potassium ions in a concentration-dependent manner with the IC50 value of 4.78 x 10^-6g/ml. Similar effects of taxine were observed in the endothelium-denuded aortic strips. Taxine produced concentration-dependent negative inotropic and chronotropic effects on isolated atrium preparations. Taxine also reduced the amplitude of peristaltic movements of the jejunum. These data confirmed that taxine has calcium channel antagonistic activity. It was found that taxine was about 13 times more selective for the heart than the vessel and 51 times more selective for the heart than the intestine with respect to inotropic effects. When compared with relative selectivity between heart and vessel, taxine is about 14 and 126 times more selective for the heart than verapamil with respect to inotropic and chronotropic effects. The leaf powder (500 mg) was given with honey in Siddha treatment (Murugesamudhaliar, 2008).

**Piper longum**

*Piper longum* L. is commonly called as long pepper in English and *Thippili* in Tamil, which belongs to the family Piperaceae (Figure 3). It is a perennial climber native to India. The stems have nodes where the fruitful branches and leaves are born. It has adventitious roots. Leaves are numerous, stalked and cordate at the base with 7 veins. The inflorescence is a pedunculated spike which was precontracted by 60 , which is used in restored the enzyme activity and the flowers are yellow and arranged in a spiral along the spine. The fruits are drupe, turns to black during maturation. Piperine is the major phytochemical component in this plant.

Antiatherogenic effect of *P. longum* was evaluated in hypercholesterol rabbit model (Ma et al, 2008). Animals were fed for 60 days and blood samples were taken and analyzed. Compared with control, the total cholesterol, triglyceride and LDL-cholesterol levels were reduced and the HDL-cholesterol was raised in the *P. longum* treated group. Also, the serum superoxide dismutase and nitric oxide levels were raised while malondialdehyde level was reduced in the extract fed group. Area percentage of aorta plaque was reduced in the extract treated group. Observation through transmission electron microscope indicated that the fine structure of aortal pathological degree was markedly abated by *P. longum* treatment and thus it could inhibit the atherogenesis and therefore prevent hypertension. It is one of the ingredients of *Thaneer vittan neyi*, which is given two tea spoons once a day in Siddha system of medicine (Kuppusamymudhaliar, 1987; Formulary of Siddha Medicines, 1993).

**Bacopa monnieri**

*Bacopa monnieri* (L.) Pennell (*Brahmi* in Tamil and Thyme leaved gratiola in English) belongs to the family Plantaginaceae (Figure 3). Its ability to grow in water makes it a popular aquarium plant. The leaves of this plant are succulent, oblong and 4–6 mm thickness, oblongate and are arranged oppositely on the stem. The flowers are small and white, with five petals. Bacopaside, bacopasapide and bacopasaponin are the major phytochemicals present in this plant.

Intravenous *B. monnieri* (20–60 mg/kg) was tested on arterial blood pressure and heart rate of anaesthetized rats (Kamkaew et al, 2011). *In vitro* vasorelaxation was assessed in arteries, with and without blockers of nitric oxide synthase, cyclooxygenase and mechanical deendothelialisation. Intravenous *B. monnieri* extract decreased systolic and diastolic pressures without affecting the heart rate. In tail artery, *B. monnieri* inhibited potassium ion-depolarization induced calcium influx from the sarcoplasmic reticulum. *B. monnieri* extract reduces blood pressure partly via releasing nitric oxide from the endothelium, with additional actions on vascular smooth muscle calcium homeostasis. Some *B. monnieri* ingredients have antihypertensive and vasodilation actions, which accounts for its medicinal use. It is the main ingredient of *Brahmi nei*, a Siddha drug which was given (15 ml) once a day for treating blood pressure (Siddha Formulary of India, 1992).

**Asparagus racemosus**

*Asparagus racemosus* Willd. (Family: Asparagaceae) is known as Wild Asparagus in English and *Thanneer vittan kizhangu* in Tamil (Figure 3). It has small pine-needle-like phylloclades that are shiny green. It produces minute, white flowers on short, spiky stems, and its fruits are blackish-purple and globular berries. It has an adventitious root system with tuberous roots, tapering at both ends, with roughly a hundred on each plant. This plant was found to possess phytochemicals like asparagusine, sapogenin, sarsapogenin, diosgenin and shatavarin.

Velavan and Hazeena Begum (2007) have evaluated the medicinal role of *A. racemosus* root extract on accumulation of oxidative damage products in heart lysosomes of aged rats. Male albino rats were treated with *A. racemosus* extract (500 mg/kg bw) for four weeks, which inhibited the accumulation of age-related oxidative damages and restored the enzyme activity and decreased the lipofuscin content in heart lysosomes. This restorative activity of *A. racemosus* mainly attributed to the alleviation of oxidative stress, associated with aging and hypertension. It is one of the ingredients of *Thaneer vittan neyi*, which is used in Siddha system of medicine by giving two tea spoons per day (Kuppusamyudhaliar, 1987; Formulary of Siddha Medicines, 1993).

**Punica granatum**

*Punica granatum* L. (Family: Lythraceae) is called as *Mathulai* in Tamil and Pomegranate in English (Figure 3). It is a small tree and has multiple spiny branches. *P. granatum* leaves are sub-opposite, glossy, narrow ob-long, entire, 3–7 cm long. The flowers are bright red...
with three to seven petals. The edible fruit is a berry-

with rounded shape and thick, reddish skin. The num-

ber of seeds in a pomegranate can vary from 200 to

1400. Various phytoconstituents like punicalin, punic

acid, punicalagin and punicatolin are present in this

plant.

The whole fruit extract of pomegranate was investigat-
ed for cardioprotective effect in rat model (Fard et al,

2011). Male Wistar rats were administered with P. 
granatum extract (100 mg/kg). The P. granatum ex-

tract treated group showed increased heart rate, sig-
nificant decrease in creatine kinase, lactate dehydro-
genase and no change in aspartate aminotransferase.

There was significant increase in the level of reduced

glutathione, whereas inhibition of lipid peroxidation and increase in superoxide dismutase concentration in the P. granatum extract treated group. Histopathologi-

cal study of the P. granatum extract treated group

showed slight protection against myocardial toxicity.

These results indicated that P. granatum extract has a

cardioprotective effect and thus it could prevent hy-
pertension. It is one of the main ingredients of Mathu-

lai nei, which is given 15 ml once a day to treat blood

pressure in Siddha system of medicine (Kup-

**Syzygium aromaticum**

*Syzygium aromaticum* (L.) Merrill & Perry is called as Kirambu in Tamil and Clove in English, which belongs to the family Myrtaceae (Figure 4). It is an evergreen tree that grows up to 8–12 m tall, with large leaves and sanguine flowers grouped in terminal clusters. The flower buds gradually turn into green, then transition to a bright red when ready for harvest. Clves are har-

vested at 1.5–2.0 cm long, and consist of a long calyx that terminates in four spreading sepalas, and four uno-

pened petals that form a small central ball. Cinnamonal-

dehyde, carvacrol and eugenol are the major chemical compunds present in this plant.

Aqueous extract of clove was analyzed for anti-

atherosclerotic activity in hypercholesterolemic zebra

fish (Jin and Cho, 2011). Clove had the strongest inhibi-
tion against copper-mediated LDL oxidation and phag-

cytosis by macrophages. The extract had potent cho-
esteryl ester transfer protein inhibitory activity in a con-

centration-dependent manner. It also exhibited hylolipidemic activity in a hypercholesterolemic zebrafish model. The clove extract-treated group had a 68% and 80% decrease in serum cholesterol and tric-

lyceride levels, respectively. The clove extract-fed group had the smallest increase in body weight gain and also showed strong antioxidant activity. Hydro-

philic ingredients of clove showed potent activities to suppress the incidence of atherosclerosis via strong antioxidant potential, prevention of apo-A-I glycation and LDL-phagocytosis, inhibition of cholesteryl ester transfer protein and hypolipidemic activity. It is used as one of the ingredients of Elathi Churnam in Siddha system of medicine, which is given 0.5 g twice a day with honey to control hypertension (Kuppusamymudhaliar, 1987; Formulary of Siddha Medicines, 1993).

**Elettaria cardamomum**

_Elettaria cardamomum_ L. (Family: Zingiberaceae) is known as Elakkai in Tamil and Cardamom in English (Figure 4). It has a tuberous horizontal rhizome, sending up from eight to twenty erect, simple, smooth, green and shining, perennial stems, which rise from six to twelve feet in height, and bear alternate elliptical-

lanceolate sheathing leaves. The flowers arranged in a panicle. The fruit is a three-celled capsule, containing many seeds. As a spice, cardamom is used for culinary purposes in curry, coffee, cakes, and bread and for flavoring sweet dishes and drinks. Cineole, limonene, α-pinene, borneol, camphor and α-pinene are the major phytoconstituents.

Antihypertensive potential of _E. cardamomum_ fruit powder was evaluated and its effect on some of the cardiovascular risk factors in individuals with hyperten-
sion (Verma et al., 2009). Twenty individuals with pri-
mary hypertension were administered 3 g of carda-

mom powder for 12 weeks and their blood pressure was recorded for 3 months. Administration of carda-
mom powder significantly decreased systolic, diastolic and mean blood pressure and increased fibrinolytic activity at the end of 12th week. Total antioxidant status was also significantly increased by 90% at the end of 3 months. Thus, this study demonstrated that consump-
tion of small amount of cardamom effectively reduces the blood pressure and improves antioxidant status, without altering blood lipids in hypertensive individu-
als. It is used as one of the ingredients of _Elathi Churnam_ in Siddha system of medicine (Kup-
pusamymudhaliar, 1987; Formulary of Siddha Medi-
cines, 1993)

**Myristica fragrans**

*Myristica fragrans* Houtt (Family: Myristicaceae) is called as Nutmeg in English and _Jathikkai_ in Tamil (Figure 4). It is an evergreen tree with 25 feet high, has a greyish-brown smooth bark. The branches spread in whorls with alternate leaves, on petioles about 1 inch long, elliptical, glabrous, obtuse at base; acuminate and aromatic. Flowers are dioecious, small in axillary racemes. Male flowers three to five more on a peduncle. In female flowers pedicel is often solitary. Fruit is a pendulous, globose drupe, consisting of a succulent pericarp. The seed or nutmeg is firm, fleshy, whitish, abounding in oil. Phytochemicals like myristicin, pi-

nene, thujen, camphene, terpinene, myrcen, fellan-
drene, caryn were present in this _plant_.

In nutmeg-pretreated ISO-administered rats a signifi-
cant decrease in the levels of blood glucose, plasma 
lipids and lipoprotein lipase activity was observed
along with no change in muscle fibres. Also the biochemical and histology parameters were nearly normal in rats treated with nutmeg. Nutmeg possesses protection effect against hyperlipidaemia and cardiac tissue damage during myocardial infarction and thus helpful in preventing/treating hypertension. In Siddha system of medicine, the dry nutmeg fruit powder (200 mg) was given with honey to control hypertension (Kuppusamy Mudhaliar, 1987).

**Pergularia daemia**

*Pergularia daemia* (Forssk.) Chiov. is known as Dog’s bane whitelow plant in English and *Veliparuthi* in Tamil (Figure 4). It is a perennial vine in the Apocynaceae family, with opposite and broadly ovate leaves. The leaves are almost glabrous above and velvety below. The flower corolla forms a greenish-yellow tube. The fruits mature and release ovate seeds covered with velvety hairs. This plant was found to contain amyrin, betaine, hyperoside, daemine, uzarogenin, coroglaucigenin, calactin, corotoxigenin, uscharin, dihydrocalotropagenin and uacharidin.

Karthishwaran and Mirunalini (2012) investigated the antioxidant potential of methanolic extract of aerial parts of *P. daemia*. The plant extract was tested for their scavenging effect against radicals such as ABTS, DPPH, nitric oxide and reducing power assays. Based on IC values obtained, *P. daemia* contains more powerful antioxidant compounds than gallic acid. Pretreatment with *P. daemia* (200 mg/kg bw) to oxidative stress induced animals significantly increased the levels of plasma and erythrocyte vitamin C, vitamin E and reduced glutathione where as the levels of vitamin E and reduced glutathione in the buccal tissue were increased. *P. daemia* exhibited strong antioxidant activity.
Vitex negundo

Vitex negundo L. (Family: Lamiaceae) is called as five leaved chaste tree in English and Nochi in Tamil (Figure 4). It is an erect small tree growing up to 3 m height. The bark is reddish-brown. Its leaves are digitate with five lanceolate leaflets. Each leaflet is around 4 to 10 cm in length, with the central leaflet being the largest and possessing a stalk. The leaf edges are serrated and the bottom surface is covered with hair. Numerous flowers are borne in panicles and each flower is around blue in color. The petals are of different lengths, with the middle lower lobe being the longest. Both the corolla and calyx are covered in dense hairs. The fruit is a succulent drupe, 4 mm in diameter, round shaped and
black when ripe. The principal constituents in this plant are casticin, isoorientin, chrysophenol, luteolin, sabinene and globule.

Khan and Gilani (2015) studied the anti-hypertensive action of *V. negundo*. The crude extract of *V. negundo* produced a dose-dependent (10-100 mg/kg) fall in the arterial pressure of rats. It also inhibited the low (25 µM) and high (80 µM) potassium-induced contractions in aortic ring. They showed the non-specific type of potassium channels activation in the vasodilatory effect of *V. negundo*. *V. negundo* extract (0.1-10 mg/ml) caused inhibition of atrial force and rate of spontaneous contractions in isolated guinea-pig. Thus *V. negundo* exhibited blood pressure lowering, vasodilator and cardiac suppressant activities, mediated predominantly through potassium channel activation combined with calcium channel inhibition. It is one of the ingredients of *Muthu Chippi Parpam*, which is given

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Figure 3: Medicinal plants used in the Siddha system of treatment for hypertension

- **Piper nigrum**
- **Maranta arundinacea**
- **Zingiber officinale**
- **Smilax china**
- **Ocimum sanctum**
- **Piper cubeba**
- **Smoussurea lappa**
- **Taxus baccata**
- **Piper longum**
- **Azadirachta indica**
- **Luecas aspera**
- **Eclipta prostrata**
100 mg twice a day with honey in Siddha medicine (Siddha Vaidhya Thirattu, 2008; Formulary of Siddha Medicines, 1993).

**Curculigo orchioides**

It is commonly known as black Musali in English and Nilapana kizhangu in Tamil (Figure 4). Curculigo orchioides Gaertn. (Family: Hypoxidaceae) is growing as a small herbaceous plant with an elongated tuberous rootstock and lateral roots; Root stock is elongated, 5-25 cm, vertical; Leaves are narrowly linear, acute, flat with sheathing leaf bases. Flowers are born throughout the year, light yellow, bisexual, sessile and regular. Perianth six lobed, yellow, six stamens, filaments 2mm, filiform, anthers 2 mm, ovary 3 celled and. Seeds are globose, black, beaked, deeply grooved in wavy lines. Phytochemicals like lycorine, sapogenin, curculigoside, corchiocide, curculigol and curculigenin are present in this plant.

The antioxidant activity of *C. orchioides* was investigated in alloxan induced diabetic rats (Anandakirrouchenane et al., 2013). *C. orchioides* extract (200 mg/kg b.w.) was administered orally to diabetes induced rats for 21 days. Treatment with *C. orchioides* exhibited significant improvement in the activities of antioxidant enzymes (superoxide dismutase, catalase, glutathione peroxidase), non-enzymatic antioxidants (reduced glutathione, vitamin C, vitamin E) and reduced the levels of pancreatic malondialdehyde, serum alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase. The histopathological abnormalities such as cytoplasmic vacuolization of hepatocytes, leukocytic infiltration and edema in the liver and kidney of alloxan-induced diabetic rats were found to be normalized after treatment with *C. orchioides* extract. These results suggested that the extract of *C. orchioides* enhanced the antioxidant defense against reactive oxygen species and hence could exhibit antihypertensive and cardio-protective actions. It is one of the ingredients of Muthu Chippi Parpam, which is given 100 mg twice a day with honey in Siddha medicine (Siddha Vaidhya Thirattu, 2008; Formulary of Siddha Medicines, 1993).

**CONCLUSION**

Hypertension is a major problem all over the world due to life-style changes and mental stress, but we could control this issue through medicine. There is much focus on herbal medicine for treating blood pressure due to less side effects and safety when compared to modern medicine. In Siddha system of medicine, more than 60 plants are used to treat hypertension and prevent/control blood pressure. In this review, important medicinal plants employed in Siddha system of medicine were discussed in detail about their medicinal efficacy, scientific validation and method of administration. Among the medicinal herbs recommended in Siddha system, some of the medicines are already being used as foods/spices (Eg. Cumin, garlic, citrus, pepper, ginger, clove, cardamom, pomegranate) and hence such materials could be included in everyday food to prevent hypertension. Also, some of the easily and
locally available plant drugs (Rose flower, Hibiscus flower, Indian gooseberry, Neem, Cyanodon grass, Aloe gel, Sugarcane, Holy basil, Nutmeg) could be used as home remedies to control blood pressure. Information given in this review will be useful to the public about the medicinal effect and mode of intake of plant drugs used in Siddha system for controlling blood pressure.

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