AN EFFECT OF CARDIOPROTECTIVE ACTIVITY IN VARIOUS MEDICINAL PLANTS--A REVIEW

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INTRODUCTION
Cardiovascular diseases are the major health problem of advanced as well as developing countries of the world [1]. Cardiovascular diseases (CVDs) are the most prevalent cause of death and disability worldwide. CVD, a group of disorders of the heart and the vasculature, includes high blood pressure, coronary heart disease, myocardial infarction, congenital heart defects, cardiac arrhythmias, heart failure and stroke [2].

Cardioprotection includes "all mechanisms and means that contribute to the preservation of the heart by reducing or even preventing myocardial damage". Defining "Cardioprotection" as "preservation of the heart" has all theoretical implications because few important herbs will protect the human being from CVDs and gives health and quality of life. In this paper, the authors explores the effect of cardioprotective activity in medicinal plants as follows, Terminalia chebula (Kadukkai), Piper longum (Thippili), Zingiber officinale (Inji), Tinospora cordifolia (Seenthil), Asparagus racemosus (Thanneervitan), Embelia ribes (Vaaviligamang), Andrographis paniculata (Nilavembu), Nelumbo nucifera (Thaanamari), Allium sativum (Vellaipoondu), Bauhinia variegata (Mantharai).

Cardioprotective plants
Botanical name: Terminalia chebula
Tamil name: Kadukkai

Taxonomy
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Myrtales
Family: Combretaceae
Genus: Terminalia
Species: chebula

Distribution
Terminalia chebula occurs naturally from the sub-Himalayan region of Nepal and northern India, through India to Sri Lanka, Burma, Thailand, Indo-China and southern China. It has been introduced to Singapore, where it failed, but it was planted successfully in the botanical garden in Bogor, Java. It was also introduced to Peninsular Malaysia [8].

Description
A medium-sized, up to 25 m tall, deciduous tree of variable appearance, with a usually short cylindrical bole of 5-10 m length, 60-80 cm in diameter at breast height; crown rounded, with spreading branches; bark dark brown, usually longitudinally cracked with woody scales; branchlets rusty-villosus or glabrescent. Leaves alternate or opposite, thin-coriaceous, ovate or elliptic-ovate, 7-12 cm x 4-6.5 cm, rounded at base, obtuse to subacute at apex, entire, pubescent beneath; petiole up to 2 cm long, provided with 2 glands at the base of the leaf blade. Flowers in auxiliary 5-7 cm long spikes, simple or sometimes branched, about 4 mm across, yellowish-white and unpleasantly scented; calyx 5-lobed, corolla absent; stamens 10, exerted; ovary inferior, 1-celled. Fruit an ovoid or oblong-ellipsoid drupe, 2.5-5 cm long, faintly 5-angular, yellow or orange-brown when ripe, glabrous [9].

Keywords: Siddha, Cardioprotective plants, Cardiovascular diseases, CVDs

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Part used
Fruit rind

Major chemical constituents
Tannin, gallic acid, mucilage, chebulinic acid [10]

Cardioprotective activity
Terminial chebula extract pretreatment was found to ameliorate the effect of isoproterenol in lipids peroxidation and retained the activities of the diagnostic marker enzymes in isoproterenol-induced myocardial damage in rats [11]

Botanical name: Piper longum
Tamil name: Thippili

Taxonomy
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Piperales
Family: Piperaceae
Genus: Piper
Species: longum

Distribution
The plant grows in evergreen forests of India and is cultivated in Assam, Tamil Nadu, and Andhra Pradesh. Long pepper is cultivated on a large scale in limestone soil and in heavy rainfall areas where relative humidity is high.

Description
Piper longum is a small shrub with a large woody root and numerous creeping jointed stems that are thickened at the nodes. The leaves are alternate, spreading, without stipules and with blades varying greatly in size. The lower leaves are 5–7 cm long, whereas, the uppermost are 2–3 cm long. Flowers grow in solitary spikes. The fruits, which grow in fleshy spikes 2.5–3.5 cm long and 5 mm thick, are oblong, blunt, and blackish-green. The mature spikes are collected and dried as the commercial form of pippalimula. There are three grades of pippalimula: grade I with thick roots and underground stems fetch a higher price than grade II or III, which consist of thin roots, stems, or broken fragments. The commercial drug consists almost entirely of transversely cut pieces (length, 5–25 mm; diameter 2–7 mm), which are cylindrical, straight, or slightly curved; some have distinct, swollen internodes exhibiting a number of leaf and rootlet scars. The surface is a dirty light brown. The drug has a peculiar odor and a pungent bitter taste that produces numbness on the tongue.

Part used
Fruit

Major chemical constituents
Piperine and piperatine, alkaloids, tannins, phenols, coumarins, essential oil, piperlonguminine, piper longuminine

Cardioprotective activity
The effect of methanol extract of P. longum fruits was evaluated on adriamycin-induced cardiotoxicity (i.e., biochemical changes, tissue peroxidation damage, and abnormal antioxidant levels) in Wistar rats. Histopathological studies of the heart revealed degenerative changes and cellular infiltration in rats treated with adriamycin; however, pretreatment with P. longum reduced the intensity of these lesions. The results indicate that P. longum offers significant protection against adriamycin-induced oxidative stress and reduces cardiotoxicity by virtue of its antioxidant activity [12]
**Description**

*Tinospora cordifolia* is quite large, extensively spreading, glabrous, dioecious, perennial deciduous climber grows on wide range of hedges and trees, typically found growing in dry deciduous forests of tropical and subtropical regions up to an altitude of 1000 m. It produces distinct male and female flowers. Its fresh stem has a green succulent bark covered by a thin brown-bark, and the bark separates from the wood turn brown with age.

The underground roots are tubercled. Leaves 5 to 10 cm, membranous, seven to nine veins diverging from the base, somewhat roundish to 'cordate' i.e. heart-shaped (that is why the species name of the plant is 'cordifolia') with a petiole of 2.5 to 7 cm long. The unisexual flowers bloom in summer in conspicuous racemes often found longer than that of the leaves. Yellowish green male flowers are quite small, occur in few-flowered clusters in the axils of small subulate bracts while the female-flowers are usually borne singly (i.e. solitary) along the axis. In both male and female flowers, Sepals are 6 numbers, 3 outer ones very small, ovate-oblong and acute while the inner 3 are larger, membranous, broadly elliptical, concave and yellowish. Distribution of *T. cordifolia* 6 to 7 mm, rounded at both ends and papillose [15].

**Part used**

Herb

**Major chemical constituents**

Alkaloids include berberine, tinosporol, columbin, tinosporon, chasmanthin, tinosporic acid [16].

**Cardioprotective activity**

The result of the present study indicated that the prior administration of methanolic extract of *Tinospora cordifolia* attenuates isoprenaline-induced MI. The cardioprotective activity of *Tinospora cordifolia* probably related to its ability to strengthen the myocardial membrane by its membrane stabilizing activity [17].

**Botanical name:** *Asparagus racemosus*

Tamil name: *Thanneervitan*

**Taxonomy**

Kingdom: Plantae

Phylum: Eudicotyledons

Order: Primulales

Family: Primulaceae

Genus: Asparagus

Species: racemosus

**Distribution**

*Asparagus racemosus* is distributed throughout tropical Africa, Java, Australia, India, Srilanka and Southern parts of China. It is found in the tropical and subtropical regions of India, and in the Himalayas up to an altitude of 1500 m above sea level.

**Description**

*Asparagus racemosus* is a climber, climbing up to 1-3 m high. It is an extensively scandent spiny, much branched under shrub. Roots are numerous fusiform, succulent and tuberous (30-100 cm long and 1-2 cm thick) that are skin coloured externally and silvery white or white internally, arising as a cluster from the basal end of the stem. These roots are the part that finds use in various medicinal preparations. Stem is woody, sparsely covered with recurved spines. Leaves are reduced to small scales called as cladodes that are in tufts of 2-6 in a node, finely acuminate, falcate divate and constitute the main photosynthetic organs. Inflorescence is a branched raceme. The plant flowers during February–March leaving a mild fragrance in its surrounding and by the end of April, fruits can be seen with attractive red berries. Flowers are white, fragrant, solitary or fascicles have a width of 0.3-0.4 cm. Berries are globose or obscurely 3 lobed. Seeds are black in colour and hard with brittle testa [18].

**Part used**

Roots

**Major chemical constituents**

Saponins-Shatavariins

**Cardioprotective activity**

Coronary artery disease and atherosclerosis are due to an increase in serum lipid levels such as cholesterol and due to the generation of reactive oxygen species. A. racemosus root powder supplements decreased lipid peroxidation and caused a dose-dependent reduction in lipid profiles. The total lipids, total cholesterol and triglycerides in plasma and liver as well as plasma LDL (low-density lipoprotein) and VLDL (very low-density lipoprotein)-cholesterol decreased by more than 30% [19].

**Botanical name:** *Embelia ribes*

Tamil name: *Vaaivilangam*

**Taxonomy**

Kingdom: Plantae

Phylum: Angiosperms

Order: Ericales

Family: Primulaceae

Genus: Embelia

Species: ribes [20]

**Distribution**

It is an Indo-Malaysian species, reported from India, Srilanka, Singapore, Malaysia and S. China. It is found to occur throughout India in Central Himalayas, Arunachal Pradesh, Assam, Maharashtra, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. This species is globally distributed in Indo-Malaysia. Within India, it is found throughout up to an altitude of 1500 m (5000 ft).

**Description**

A large scandent Straggling shrub with a long slender brittle stem. It is a Climbing-111 creeper shrub, flexible, and terete branches; bark studded with lenticels Leaves simple, coriaceous, alternate, elliptic-ovate-lanceolate, smooth leaves gland-dotted, broad, entire perfectly glabrous. It is about 3 inch long and 1 ½ inches broad, shiny above. Petiole 1.0 cm to 0.8 cm margined, Mādīrī; prominent Flowers; small, greenish yellow to whitish pink colored. In racemes at end of branches Small, globular Fruits about the size of white pepper, reddish brown to blackish. It is found in bunches. Root; brownish grey Rootlets; hairy reddish. Fruit: The fruits are brownish-black on ageing, globular to sub-globular, 2-4 mm in diameter, and style at apex. In a few fruits, the pedicle along with persistent calyx is present. Surface is warty, pericarp brittle, enclosing a single seed, speckled with yellowish brown or white spots. Most of the seeds are striate. Transverse section of fruit shows epicarp consisting of a single row of tabular cells of the epidermis, generally not distinct due to deposition of coloring matter.

**Parts used**

Berries, roots, bark

**Major chemical constituents**

The main component of vidanga is Embelic acid: 2, 5-dihydroxy-3-undecyl-1, 4-Benzoxonone and also contains chestembeline, an alkaloid and resinoid and volatile oil [21].

**Cardioprotective activity**

Cardioprotective effect of aqueous extract of E. ribes was evaluated in a rat model having an acute myocardial infarction, induced by
isoproterenol. E. ribes significantly decreased the heart rate, systolic blood pressure, increased levels of serum lactate dehydrogenase, serum creatine kinase and myocardial lipid peroxides and significantly increased the myocardial endogenous antioxidants levels. Pretreatment with ethanol E. ribes extract against isoproterenol (ISO)-induced myocardial infarction in albino rats significantly (p<0.01) decreased the elevated levels of LDH and CK in serum and myocardial TBARS and increased the reduced levels of GSH, SOD and CAT in heart homogenates. Histopathological observation revealed marked protection by the extract in myocardial necrotic damage.

The results of this study provide evidence that ethanol E. ribes extract treatment enhances the antioxidant defense against ISO-induced myocardial infarction in rats and exhibits cardioprotective properties.

The protective effect of E. ribes on isoproterenol (ISO)-induced cardiomyopathy in streptozotocin (STZ)-induced diabetic rats was studied by treatment of E. ribes ethanol extract (200 mg/kg) on pathogenic (STZ+ISOtreated) rats resulted in a significant (p<0.01) increase in HR, blood glutathione, serum LDH, and myocardial endogenous antioxidant levels with a significant (p<0.01) decrease in BP, blood glucose, HbA1C, serum CK, and myocardial TBARS levels [22].

Botanical name: *Andrographis paniculata*

Tamil name: *Nilavembu*

Taxonomy

Kingdom: Plantae
Order: Personales
Family: Acanthaceae
Genus: *Andrographis*
Species: *paniculata*

Distribution

*A. paniculata* is native to Taiwan, Mainland China, and India. It is also commonly found in the tropical and subtropical Asia, Southeast Asia, and some other countries including Cambodia, Caribbean islands, Indonesia, Laos, Malaysia, Myanmar, Sri Lanka, Thailand, and Vietnam. This plant is also found in different phytogeographical and edaphic zones of China, America, West Indies, and Christmas Island.

Description

*Andrographis paniculata* grows erect to a height of 30–110 cm (12–43 in) in moist, shady places. The slender stem is dark green, squared in cross-section with longitudinal furrows and wings along the angles. The lance-shaped leaves have hairless blades measuring up to 8 cm (3.1 in) in length and 2.5 cm (0.98 in). The small flowers are borne in spreading racemes. The fruit is a capsule around 2 cm (0.79 in) long and a few millimeters wide. It contains many yellow-brown seeds [23].

Part used

Roots

Major chemical constituents

Andrographolide

Cardioprotective activity

Andrographolide protects the cardiac myocytes against hypoxia/reoxygenation injury and antioxidant activity [16].

Botanical name: *Nelumbo nucifera*

Tamil name: *Thaamarai*

Taxonomy

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Liliopsida
Order: Liliales
Family: Liliaceae
Genus: *Nelumbo*
Species: *Nelumbo nucifera*

Description

The sacred lotus is a perennial aquatic plant with rhizomes (often mistakenly called ‘roots’) that grow in the mud at the bottom of shallow ponds, lakes, lagoons, marshes and flooded fields. It’s large, peltate (with the leaf-stalk attaching to the centre, rather than the edge) leaves rise above the water surface on 1 to 2 m long petioles 4–6. Lotus grows to a height of about 150 cm, with a 3-meter horizontal spread. The leaves can be as large as 60 cm in diameter, while the showy flowers can be up to 20 cm in diameter. The fruits are a conical pod, with seeds contained in holes in the pod. Leaves are large, of both types, aerial as well as floating orbicular 20-90 cm in diameter. The usual length varies from 24.00 to 33.00 cm, in case of aerial leaves and 23 to 30 cm in case of floating, petioles are smooth, greenish or greenish brown in color with small brown dots sometimes rough with very small, but distinct prickles, odor is distinct, fracture is fibrous. Seeds fill in the ripe carpe, white pink or pinkish-white fragrant peduncles arising from the nodes of the rhizomes, sheathing at the base, 1-2 cm long, green or blackish green, hard and stout, smooth or rough due to the presence of numerous small scattered prickles, sepalts, petals and stamens are spirally arranged passing gradually one into another. The rhizomes are 60-140 cm long 0.5 to 2.5 cm in diameter. When freshly cut is exudes mucilaginous juice and show a few large cavities surrounded by several larger ones, fracture is tough and fibrous. Odor is indistinct [24].

Parts used

Flowers

Major chemical constituents

Quercetin, luteolin, alkaloids [16]

Cardioprotective activity

Neferine's antagonized arrhythmias induced by aconitine in rats, calcium chloride in mice, and coronary occlusion-reperfusion in dogs. Neferine’s anti-arrhythmic effect may involve blocking human ether-à-go-go-related gene channels associated with repolarization of the cardiac activity potential [24].

Ethanolic extract of *Nelumbo nucifera* (150 mg/kg and 300 mg/kg p.o once daily) pretreated-ISO administered rats maintains the levels of AST, ALT, CK, and LDH near to normal. This data suggested that N. N. is effective cardioprotective effect at the dose of 150 mg/kg and 300 mg/kg p.o once daily [25].

Botanical name: *Allium sativum*

Tamil name: *Vellaipoondu*

Taxonomy

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Liliopsida
Order: Liliales
Family: Liliaceae
Genus: *Allium*
Species: *Allium sativum*

Description

It is an underground perennial bulb and grows up to 1.2m (4 ft) in height. Garlic as a whole is called either head or knob. But the individual part is known as the garlic clove/bulblets, that weights 1g...
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