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Review Article

A comprehensive review of medicinal plants for cardioprotective potential

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ABSTRACT

Cardiovascular diseases (CVDs) are a class of heart or blood vessel disorders that is considered a major cause of global mortality followed by morbidity, with an estimated 17.9 million people dying each year and the most targeted age groups are 40–50 years. In this connection, many diet-based and plant-phyto-chemical-based natural approaches are recommended to reduce the risk of CVDs by considering the chronic use of synthetic or semi synthetic drugs followed by their side effects. Natural medicines, on the other hand, are a major part of social insurance worldwide either traditionally or empirically because medicinal plants have been used as powerful remedies for the treatment and anticipation of different well-being conditions including CVDs and CNS disorders. In addition, plants have been used to help mitigate human suffering from various disruptions due to their bioactive compounds with diverse biological activities. According to literature, secondary metabolites such as flavonoids, catechins and quercetin from plant origin have been reported to have cardio-protective properties. In this regard, plants that have a strong cardio-protective and cardio-tonic impact due to their phytoconstituent properties need to be identified. By keeping this view in mind, the purpose of this review article was to provide important information of medicinal plants with cardioprotective functions.

1. Introduction

Cardiovascular disease (CVD) is considered one of the most leading causes of global morbidity followed by fatality, particularly in low- and middle-income countries including India and the incidence rates are raising day by day and cause global burden on illness and affects the quality of life (QOL) of individuals. Of all CVDs, ischemic heart disease (IHD), such as angina pectoris, myocardial infarction (MI) is the most troubling clinical disorder leading to death [1, 2]. According to data, it is also estimated that by 2030, over 23 million people will die of cardiovascular diseases each year with more incidence rates were expected in South Asian subcontinent countries. In addition to this, despite advances in the management of CVDs, MI remains the leading cause of mortality around the globe with high incidence rates around the age of 35 years, which may be due to chronic stress, lack of physical activity and lifestyle modifications, etc [3, 4].

Cardio-protection (CP) is a means of protecting the heart from damage caused by various insults, including ischemia, ischemia and reperfusion. Cardio-protection involves a few regimens that appear to have saved the capacity and rationality of cardiac muscle tissue exposed to ischemia or re-oxygenation [5].

Natural medicines, on the other hand, are a major part of social insurance worldwide. Plants have been used to relieve human suffering since the beginning of human culture with their natural bioactive compounds, called phytochemicals, which are derived from various natural resources such as vegetables and fruits with active phytonutrients to combat various diseases and disorders in humans.

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2. Perspective on cardioprotective plants

Plants are a primary source of conventional medicines used for treating different ailments. 35,000-70,000 species of plants have been evaluated for medicinal use to date [6]. Around 4,22,000 flowering plants have been recorded worldwide, according to the literature, of which more than 50,000 plants are of medicinal value that is used for pharmaceutical purposes. Approximately 80% of the world's populations rely on conventional medicines for primary healthcare needs [7–9]. Moreover, Plant-based natural medicine is an important health resource with many applications, particularly in the prevention and management of lifestyle-related chronic diseases, including cardiovascular disorders and metabolic syndromes.

Many countries are trying to increase the coverage of critical health services by using natural resources available to tackle different ailments. In view of cardioprotection, bioactive agents from natural sources have gained fundamental importance in reducing the risks of cardiac ailments by scavenging free radicals formation. In keeping with this, this review article highlights the important information of medicinal plants such as *Asparagus racemosus, Bauhinia variegata linn, Cocos nucifera, Ficus hispidia, Glycyrrhiza glabra, Hydrocotyle asiatica, Mangifera indica, Ocimum basilicum, Picrorhiza kuroda, Curcuma longa, which* are known to their cardioprotective properties in traditional medicine.

3. Cardioprotective plants

3.1 Asparagus racemosus

Shatavari (Table.1) is a Liliaceae family plant (Figure 1) and can be found at low altitudes in covert and tropical environments throughout India, Asia, Australia, and Africa. Shatavari is a woody graduate with a 1–2 m range. After pine needles, the leaves are almost nothing and uniform. The inflorescence has a small number of white blooms fingerlike and arranged in small spikes. The Shatavari has cell-helping, antidiarrheal, diabetic, and immunomodulatory properties. Te Asparagus racemosus base is mixed with emollient, cooling, nervous tonic, preventative, sexual enhancer, diuretic and carminative, stomach, pure and tonic. Asparagus racemosus is a well-known Ayurvedic Rasayana for anxiety, dyspepsia, tumors, discomfort, neuropathy, and hepatopathy. The rasayana is a powerful foreshore forest that extends life, boosts resistance and improves mental ability, energy, and imperativities. [10] Aqueous extracts of Asparagus racemosus have been reported to significantly reduce the damage caused by Doxorubicin to rat myocardium due to its antioxidant properties due to the presence of polyphenols and flavonoids [11].

3.2 Bauhinia variegata linn

Bauhinia Variegata Linn (Figure1) is commonly known as Mountain Ebony (Table.1). It belongs to the family of Caesalpinacea. Situated across the Indians and reaching 1,300 meters in the Himalayan, this plant is widely distributed in a small, medium-sized leafy tree. The leaves of the tree are drained in November and December and new leaves emerge in March and April. The flowering occurs in February. The leaves are 10–20 cm long and wide, adjusted, bi-lobed at base and at the apex, prominent, glorified rose or white, 8–12 cm wide, five petals of fruit are 15–30 cm long, and have some seeds in them. The tree is a small to medium-sized deciduous trees growing to 10–12 meters high.

The bark sections are primarily used to prevent infection, malaria, torment reduction, declining spread, cytotoxicity, fieber reduction, and the control of thyroid hormones. The wound, ulceration, scrofulasis, protoptosis, hemorrhoids, hack, minor hypocrytes, and draining issues are traditionally used for treating skin and glandular conditions, disease, intestinal wormed diseases, tumors, wounds and diseases. According to the report, The stem contains sitosterol (4-O—- L-raemnopyranosyl-glucopyranosides), lupeol, kaempferol3-glucoside and5.7-dihydroxy and5.7-dimethoxy, while the flowers contain various glycosides and flavonoids such as quercetin, rutin, apigenin, and 7-O-glucoside apigenin [12].

3.3 Cocos nucifera

Cocos nucifera (L.) (Figure 1), also known as coconut or coconut-of-the-sea-coast, is a significant member of the Arecaceae family (Table.1). The crop comes from Southeastern Asia and the India-Pacific islands. The coconut palm product is accepted for transportation from this region into India and then East Africa.The plant is an arborescent monocotyledonous tree with a thick covering that grows to around 25 meters in height (mammoth coconut). Fasciculate is the foundation of the coconut structure. The stem is un branched, and a tuft of leaves at the top of the stem ensures a single apical bud. The quill-shaped pinnate leaves have a petiole, rachis, and leaflets. Under ideal environmental conditions, goliath-grown coconut produces 12–14 spikes of inflorescence per year, while the dominant adult coconut produces 18 spikes in the same time frame. This is a monoecious plant with globular clusters of female flowers on the auxiliary inflorescence. Phytochemical studies of plant parts reported the existence of phenols, tannins, leucoanthocyanidins, flavonoids, triterpenes, steroids, and alkaloids with various biological activities, including cardioprotection due to its ability to minimize oxidative stress and cell harm, according to available records [13].

3.4 Ficus hispidia

Ficus is a genus of about 850 species in the Moraceae plant family. *Ficus hispida* (Table.1) (Figure 1) is a small tropical fig tree with a wide distribution. It has been recorded in many parts of Asia, as well as far south as Australia. The leaves, like those of many ficus, are sandpaper to the touch. The hanging figs on long stems are a unique feature. Most Ficus species are consumed by humans as a source of protein. Various parts of plants such as herbal roots, aerial roots, stem, bark, leave, latex, fruit and pulp are made of several medical importance by their diversity of bioactive phytochemical compounds such as polyphenols, phohenolic acids, triterpenoids, flavonols, anthocyanins, carotenoids, glycosides, polypsacharides, vitamins K, E, and C. Most of these phytochemical compounds have a strong antioxidant capacity, which can help reduce bio-dynamic oxidative stress and reduce lipid and free radical scavenging, through metal cellulose reduction. There is evidence for the evaluation of the plant's cardioprotective potential on cyclophosphamide-induced myocardial injury, with significant cardioprotective effect by reducing lipid peroxidation and increasing antioxidants such as superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase, glutathione-S-transferase, and glutathione-S-transferase . [14].

3.5 Glycyrrhiza glabra

Glycyrrhiza glabra Lins is a popular herb used in Ayurvedic medicine (Figure 1). Glycyrrhiza glabra Linn (Table.1) is a 2.5-meter-tall perennial shrub. The leaves are composed of 4–7 pairs of oblong, elliptical, or lanceolate leaflets that are imparipinnate and alternate. The lavender to purple flowers are narrow, papilionate, and borne in axillary spikes. The calyx is small, bell-shaped, and has a glandular hair on the lanceolate tip.

Glycyrrhiza glabra, *Glycyrrhiza uralensis*, *Glycyrrhiza inflata*, *Glycyrrhiza aspera*, and *Glycyrrhiza korshinskii* are among the 30 species

in the genus *Glycyrrhiza*, also known as licorice.The fruit is compressed leguminous or pod that is up to 1.5 cm long, erect, glabrous, and slightly reticulate, with 3–5 brown, reniform seeds. The horizontal woody stolons grow from the taproot, which is about 1.5 cm long and subdivided into subsidiary roots, each about 1.25 cm long. When dried and cut together with the root, they can reach a height of 8 meters and produce commercial licorice. The major phytoconstituents were found in licorice include triterpene saponins, flavonoids, coumarins that exert diverse biological effects [15].

According to the earlier studies, Licorice and its metabolites have cardioprotective effects in rats owing to their antioxidant properties. In another study, thirty days of licorice intake-improved heart function and preserved cardiomyocyte histology, possibly due to an increase in endogenous antioxidants or a reduction in oxidative stress, and licorice delays the progression of cardiovascular disease. Glycyrrhiza glabra also protects the rat myocardium from isoproterenol-induced oxidative stress by decreasing lipid hydroperoxides and isoprostanes while increasing superoxide dismutase and glutathione levels [16–17].

3.6 Centella asiatica

Centella asiatica (L.) is a tropical medicinal plant that belongs to the Apiaceae family and is found worldwide, especially in Asian countries (Figure 1). It is a creeper plant with a long stalk that can reach a height of 15 cm Brahmi, also known as the Indian pennywort, is another name for it (Table.1).

Asiatica is a spreading perennial plant that spreads by stolons. Pale or spade-shaped leaves with scalloped edges support the plants, which are supported by long petioles clustered at the stem nodes. The seeds are pumpkin-shaped nutlets 3–5 mm in length, and the flowers are insignificant green or pinkish-white flowers borne in thick umbels.Pentacyclic tri-terpenoids, such as asiaticoside, brahmoside, asiatic acid, and brahmic acid, madecassic acid, and madecassoside are the main phytoconstituents. It grows in tropical and subtropical swampy areas around the world. It is native to the tropical regions of Asia, including the Indian subcontinent, Southeast Asia, Malaysia, and the Solomon Islands, as well as some temperate areas of China, Japan, Korea, and Taiwan [18].

In vivo studies have shown that oral administration of 200 mg/kg of *Centella asiatica* aqueous extract to adriamycin-induced rats increased the activities of cardiac marker enzymes such as lactate dehydrogenase, creatine phosphokinase, glutamate oxalate transaminase, and glutamate pyruvate transaminase, as well as enhancement of antioxidant enzyme activity. In another study, 25 mg/kg of asiatic acid, an essential phytoconstituent of Centella asiatica, enhanced cardiac dysfunction and reduced left ventricular remodeling in a rat model of myocardial infarction. Centella asiatica also has a protective role against ischemia-reperfusion injury-induced myocardial infarction in Wistar rats by lowering lipid peroxidation, inflammatory, and apoptotic markers [19–20].

3.7 Mangifera indica

Mangifera indica (MI) (Figure 1), also known as Mango, has been an important herb in the Ayurvedic and Indigenous medical systems for more than 4000 years. Mangoes are members of the genus Mangifera, which

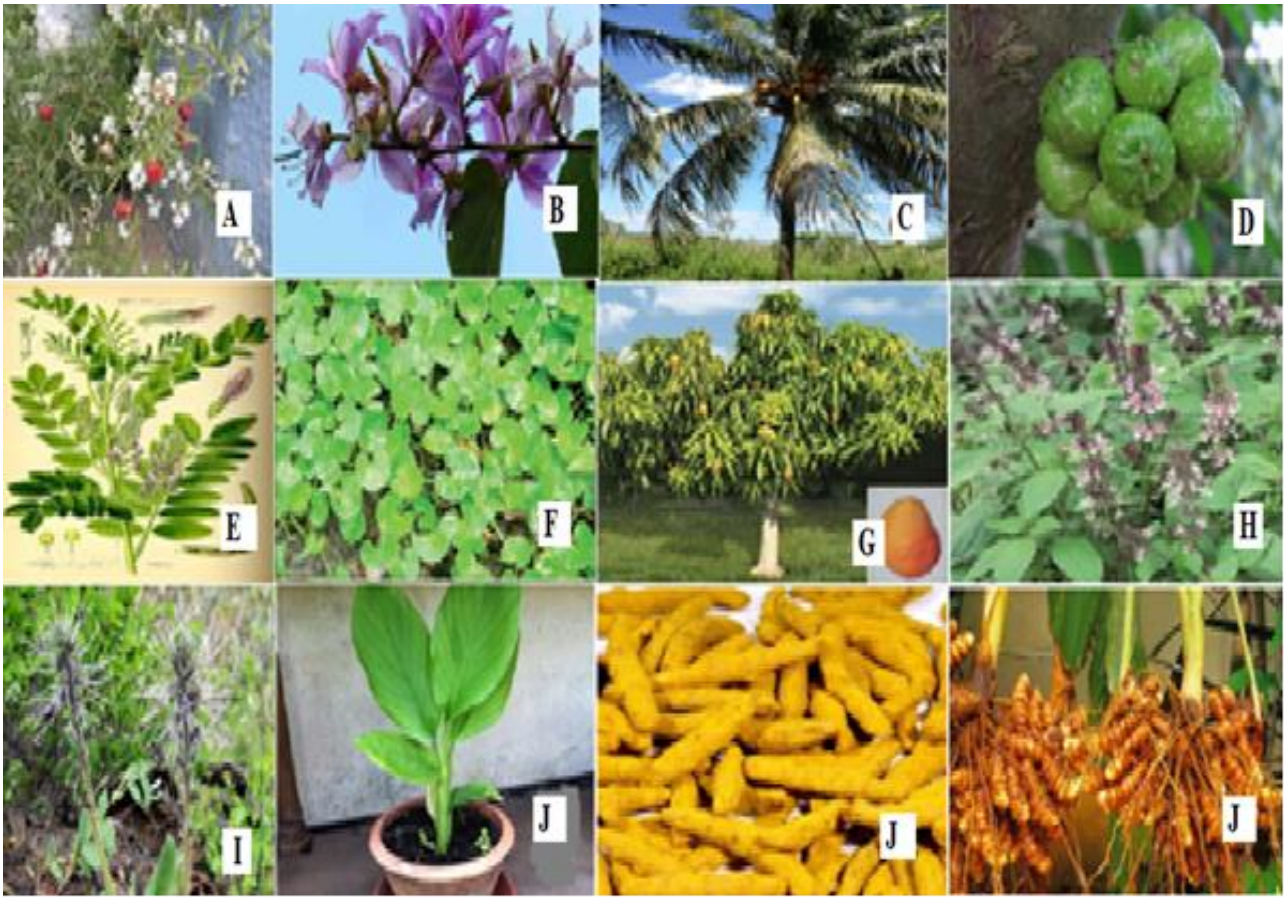

Figure 1: Different medicinal plants exerting cardioprotective activity.
[A] Asparagus racemosus [B] Bauhinia variegata linn [C] Cocos nucifera [D] Ficus hispidia [E] Glycyrrhiza glabra [F] Hydrocotyle asiatica [G] Mangifera indica [H] Ocimum basilicum [I] Picrorhiza kuroa [J] Curcuma longa

includes about 30 tropical fruiting trees in the Anacardiaceae flowering plant family. Mangifera has good antioxidant, anti-hyperlipidemic properties along with immunomodulatory, cardiotonic, hypotensive, wound-healing, antidegenerative, and anti-diabetic properties (Table.1).

Various parts of the plant are used as Dentifrice, Antiseptic, Astringent, Diaphoretic, Stomachic, Vermifuge, Tonic, Laxative and Diuretic and for treating diarrhea, Dysentery, anemia, Asthma, Bronchitis, Cough, Hypertension, Insomnia, Rheumatism, Toothache, Leucorrhoea, Haemorrhoea and Piles.The juice is a cooling tonic that can be used to treat heat stroke. Seeds are used for asthma and as an astringent. Fumes from burning leaves are inhaled to relieve hiccups and throat problems. The bark is astringent, is used in diphtheria and rheumatism, and is believed to have a tonic effect on the mucus membrane. The gum is used for cracked legs and scabies in dressings. It is also considered anti-syphilitic. After soaking in water, the kernels are converted into flour and the astringent principles are removed. Most parts of the tree are used medicinally and the bark also contains tannins that are used for dyeing purposes [21].

Mangiferin is a well-known xanthone that is widely distributed in the bark, peel, leaf, seed, stalk, and kernel of mango and higher plants (Mangifera indica Linn). Several studies have identified the pharmacological properties of mangiferin, including its antioxidant, anticancer, anti-aging, antiviral, hepatoprotective, analgesic, and immunomodulatory activities. Mangiferin's cardioprotective effect was studied in rats with isoproterenol-induced myocardial infarction. Mangiferin was discovered to reduce the effects of isoproterenol-induced pathological changes, lipid peroxide production, and myocardial marker enzyme activities to near-normal levels. [22].

3.8 Ocimum basilicum

Ocimum basilicum (Figure 1), also known as sweet basil (Table 1), is a member of the Lamiaceae family. In the Western Ghats region of northwest Karnataka, India, the basic oil of the blossoming elevated pieces of O. basilicum grows. The blossoming aeronautical pieces of O. basilicum were collected in May 2011 at an elevation of 800 meters in the Belgaum area. Sweet basil has traditionally been used to treat cerebral pains, hacks, loose bowels, stoppage, moles, worms, and kidney problems.

According to literature, *Ocimum basilicum* reported having triterpenoids, polyphenols, steroids, and phenylpropanoids as major phytoconstituents, in that, constituent such as basilol, ocimol, basilimoside, rosmarinic acid, hydroxycinnamic acids, oleanolic acid, and betulinic acid has shown diverse pharmacological effects in various *invivo* and *invitro-screening* models [23–25].

Furthermore, extracts of *Ocimum basilicum* have a significant antihypertensive effect in renovascular hypertensive rats and the effects are consistent with a reported effect on endothelin-converting enzyme [26]. Moreover, according to the data, Ocimum had shown significant cardioprotection against myocardial tissue damage by isoproterenol in which protective effects can be through the modulation of different antioxidants [27–28].

Table 1 List of herbs used for cardioprotective activity

Botanical name	Common name	Phyto-constituents Reported	Biological activity
Asparagus racemosus (Liliaceae)	Satavar, shatavari or Shatamull, Shatavari	Saponins, Isoflavones, Asparagamine, Racemosol, Polysaccharides, Asparagine, Arginine, Tyrosine, Flavonoids	Cancer prevention agent, Antidiarrheal, Antidiabetic and Immunomodulatory activities [10] [11]
Bauhinia variegata linn (caesalpinaceae)	Mountain Ebony	Quercetin, Rutin, Bilirubin	Chemoprevention, Hepatoprotective, Anti-diabetic activity, Tubercular activity. [12]
Cocus nucifera	Coconut tree,coco	Phenols, Tannins, Leucoanthocyanidins, Flavonoids, Triterpenes, Steroids alkaloids	Anthelminthic, Antinociceptive, Antifungal, Antimicrobial, Antitumor activities [13]
*Ficus hispida, (*Moracea)	Hairy	Alkaloids, Sterols, Phenols, Flavonoids, Glycosides, Saponins and Terpenes.	Treatment of Ulcers, psoriasis, Anemia,Piles Jaundice, Vitilgo, Diabetes,Convulsions, Dysentery, Lactagogue and Purgative [14]
*Glycyrrhiza glabra, (*Papilionaceous)	Licorice (British English) or **licorice**	Flavonoid-rich fractions include liquirtin, isoliquiritin liquiritigenin and rhamnoliquirilin	Anti-convulsant, Immunomodulatory, Hepatoprotective, Anti-inflammatory, Anti-ulcer, Antioxidant, Antiviral, Anticancer, Antimicrobial activity. [15–17]
Hydrocotyle asiatica, (Umbelliferae)	Brahami	Isoprenoids (sesquiterpenes, plant sterols, Pentacyclic triterpenoids and saponins) and Phenylpropanoid derivatives (Eugenol derivatives, Caffeoylquinic acids, and Flavonoids).	Anti-bacterial activity, Cytoxic activity.[18]
Mangifera indica, (Anacardiaceae)	Mango	Yanidin, Delphinidin and Pelargonidin, the Flavan-3-ol (+)-catechin traces of flavones apigenin and luteolin the flavonols kaempferol	Anti-bacterial activity [19]
Ocimum basilicum (Lamiaceae)	Sweet basil	Linalool, Methyl chavicol, or Citral and 1,8-cineole, Camphor, Thymol, Methyl cinnamate, Eugenol, Methyl eugenol, Methyl isoeugenol, and Elemicin	Antimicrobial, Anti-fungal[20]
Picrorhiza kuroa (Scrophulariaceae)	Kutki	Pikuroside, Veronicoside, Phenol glycosides	Against microbial, Antimutagenic, Cardio-defensive, Hepato-defensive, Hostile to malarial, Hostile to diabetic, Mitigating, against malignant growth, Against ulcer and Nephron-defensive activities [21]
Turmeric	Haldi, Haridar, Manjal	Curcumin Curcuminoids Zingiberene; β-sesquiphellanderene; Curcumenone; Dehydrocurdione; Procurcumadiol; Bis-acumol; Curcumenol	Antioxidant, Anti-inflammatory, Polyphenol[22]

3.9 Picrorhiza kuroa

Picrorhiza kuroa (Figure 1), also known as Kutki (Table 1), is a member of the Scrophulariaceae family. Kutki is a perennial herb that can be found in the Himalayan region (from Garhwal to Bhutan), West China, South-East Tibet, and North Burma. It grows in a wild structure in snow-capped areas on rock clefts and in natural soils as well. It grows on the stone's cleft on the north-bound inclines, bluffs, and frosty level turf in the Himalayan district between elevations of 3500 m and 4800m, as well as in the western areas of Nepal. It is widely used by local residents to treat various illnesses, and as a result, it puts an enormous strain on the plant population. A restorative plant is commonly used in traditional medicine to treat asthma, jaundice, fever, intestinal illness, snake chomp, and liver disease.

Iridoid glycosides, such as Pikuroside, Veronicoside, and phenol glycosides, are the most active constituents, exerting various biological effects. Antimicrobial, antioxidant, and antibacterial properties have been observed for these phytoconstituents. Antimutagenic, antimutagenic, antimutagenic, antimutagenic, antimutagenic, According to reports, the compound has cardio-defensive, hepato-defensive, anti-malarial, anti-diabetic, relaxing, anti-malignant growth, anti-ulcer, and cardioprotective properties [29].

3.10 Curcuma longa

Curcuma longa (Figure 1) is a member of the Zingeberaceae family and is commonly known as Haldi (Table.1). Turmeric is a byproduct of *Curcuma longa*, a tropical South Asian rhizomatous herbaceous affliction. Curcuma has been found in 133 varieties around the globe. Plants are gathered for their rhizomes once a year, and a part of those rhizomes is reseeded the following season. Turmeric comes from a tuberous rhizome that has an unappealing and portioned skin.

The rhizomes grow beneath the soil's surface foliage. They have a yellowish black interior and a dull orange exterior. Smaller tubers diverge from the underlying rhizome, which is pointed or narrowed at the distal end and measures 2.5–7.0 cm (1–3 inches) in length and width. The dried turmeric rhizome is ground into a yellow powder with a tough, slightly bitter, but sweet taste. Among the constituents are cell reinforcement, antimutagenic, antimicrobial, and anticancer properties [30].Curcumin appears to protect rats from isoproterenol-induced myocardial infarction and reperfusion-induced myocardial injuries, according to a review of the literature. Also, Curcumin is one of the most appealing compounds to have multiple protective roles due to its nontoxic nature and various systemic beneficial effects.

4. Conclusion

This review focused on some of the medicinal plants associated with cardioprotective properties in the past and have been discussed in the literature due to their active phytoconstituents. According to the data, phyto-constituents like sulforaphane, catechin, diosgenin, isoflavones, and quercetin have cardioprotective effects. These constituents work by eliminating complex variables, inhibiting primary factors, enzymes, and scavenging oxygen-free radicals, though the precise molecular mechanisms are still unknown. This review provided crucial information on the medicinal plants described, as well as reported phytoconstituents.

Conflict of Interest

The author(s) confirm that this article content has no conflict of interest.

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