

Plant & its Bioactive Components Uses in Cardio-Potential Diseases: A Sectional Study for Different Herbs

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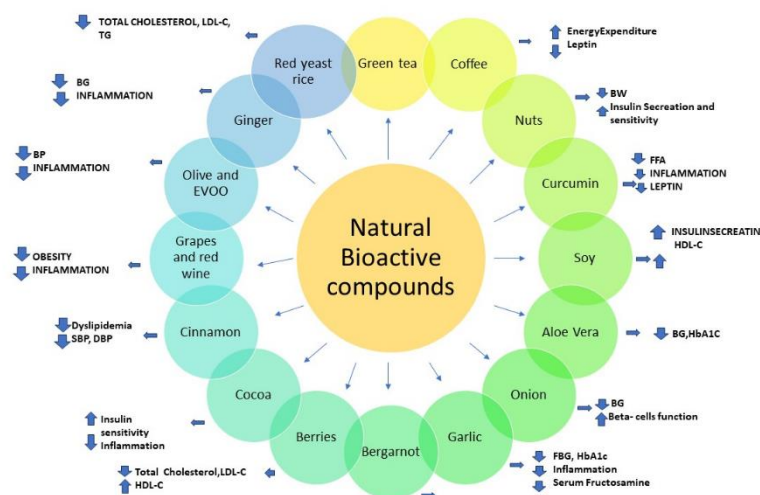
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GRAPHICAL ABSTRACT



ABSTRACT

Thirty percent of all deaths that occur each year can be attributed to heart disease, stroke, and other forms of cardiovascular disease. The World Health Organisation (WHO) predicts that by the year 2030, the annual death toll from cardiovascular diseases will have increased to 22.2 million, up from the present annual total of 17.9 million. Mortality rates tend to go up in populations as they get older. The chance of dying from cardiovascular disease is significantly higher for females (51%) than it is for males (42%). The majority of people treat and prevent cardiovascular disease by using plant-based medications (also known as phytochemicals), either in addition to or in instead of pharmaceuticals that are readily available on the market. In this study, the efficacy of treating cardiovascular illness is evaluated using 92 different plants, including 15 terrestrial plants. A number

of different medicinal herbs, including *Daucus carota*, *Nerium oleander*, *Amaranthus Viridis*, *Ginkgo biloba*, *Terminalia arjuna*, *Picrorhiza kurroa*, *Salvia miltiorrhiza*, *Tinospora cordifolia*, *Mucuna pruriens*, *Hydrocotyle asiatica*, *Bombax ceiba*, and *Andrographis paniculate*, are utilised to treat cardiovascular disease. There are a variety of active phytochemicals found in these plants, some of which include flavonoids, polyphenols, plant sterols, plant sulphur compounds, and terpenoids. Flavonoids, in general, are known to increase vasodilation by inhibiting the oxidation of low-density lipoprotein (LDL). Plant sterols reduce the amount of cholesterol in the blood, which in turn protects against cardiovascular disease. Plant sulphur compounds protect against cardiovascular disease in addition to their role in the activation of nuclear factor-erythroid factor 2-related factor 2 (Nrf2) and the inhibition of cholesterol formation. The incidence of cardiovascular disease can be reduced by increasing the synthesis of ATP in mitochondria, and terpenoids can diminish atherosclerotic lesion in the aortic valve. Even though several physiologically active compounds with acknowledged biological functions have been found in a wide variety of plants, the prevalence of cardiovascular disease continues to rise, making it imperative that effective CVD prevention and treatment strategies be developed. More research is required to understand both the mechanism and the individual phytochemicals in plants that treat CVD.

Keywords- CVS Disease, ADR, Bioactive compounds, Herbal drugs.

I. INTRODUCTION

Herbal therapies are making a comeback in modern medicine since antibiotics and other conventional drugs are no longer as powerful as they once were against even the deadliest of infections. About 2,000 plant species are recognized as having therapeutic significance in Ayurveda (ancient Indian medicine), whereas approximately 5,700 traditional medicines, the vast majority of which are derived from plants, are included in the Chinese Pharmacopoeia [1]. Despite the fact that current medications are helpful in managing the symptoms of cardiovascular disease, they are not without their own set of drawbacks [2]. Benefits such as greater patient acceptance and lower cost make certain ayurveda formulations a clinically useful therapy for a variety of illnesses [3, 4]. Many of these formulations, however, lack controlled research either supporting or refuting their purported pharmacological activity. Since cardiovascular treatments are typically taken for extended periods of time, current investigations on ayurveda cardiogenic formulations are of crucial importance. MHR is a compound herbo-mineral formulation used frequently in the treatment of heart conditions [5]. *Aconitum ferox*, *Solanum indicum*, *Piper nigrum*, and *Piper longum* are the four types of herbs used to make the medicine. According to Ayurvedic literature [6], one MHR tablet consists of one part powdered processed *Aconitum ferox*, one part powdered processed *Solanum indicum*, one part powdered processed *Piper nigrum*, and one part powdered processed *Piper longum*, all mixed with one part purified sulphur and one part purified sodium metaborate, and then sieved. Two parts of pure cinnabar (HgS) were added to the mixture and thoroughly combined. Synergistic interactions between the various plant components in this formulation boost activity and even neutralise the toxicity of some chemicals [7]. The poisonous diester-diterpene alkaloids found in aconite root include the well-known cardiogenic [8], anti-inflammatory, and analgesic [9] alkaloid aconitine. Aconitine has an LD50 in mice of 1.8 mg/kg. As part of the cleaning process, *Aconitum* roots are soaked in cow urine for 48 hours before being washed

in cow milk. After that, you need to wash the roots and let them dry [10]. The LD50 for -Solanine, a poisonous glycoalkaloid found in *Solanum* roots, is 0.68 mmol/kg in mice [11]. This formulation also poses a significant risk to human health due to the presence of heavy metals [12]. The toxicity of the active components in MHR was reduced and their bioactivity was enhanced through the application of a traditional ayurvedic procedure called shodhana (purification) [13]. Adverse effects of the formulation may be seen in people if this step is skipped or not done according to the standard text [14]. There have been no well-controlled scientific studies of MHR's toxicological or pharmacological qualities. As a result, it's crucial that doctors and farmers understand MHR's benefits and safeguards. To back up the claims made by Ayurveda and other traditional healers, and to offer a foundation on which to demonstrate the safety of such formulations, the present studies have been conducted to investigate the toxicological and pharmacological effects of MHR. Here, we looked into whether or not different MHR preparations could prevent heart damage that had been caused in the lab. We utilised the nonselective -adrenergic agonist isoproterenol (ISO; 1-(3',4'-dihydroxyphenyl)-2-isopropylaminoethanol hydrochloride), which produces infarct-like necrosis of the heart muscle in rats [15-17], followed by leaking of cardiac enzymes into the circulation. The cardioprotective effects of MHR were investigated in rats exposed to isoproterenol. We used the rat embryonic cardiac cell line (H9c2) to investigate the cytotoxicity of the MHR formulation further. To verify the efficacy of the purification method employed, chromatographic analysis of a subset of MHR formulations was carried out.[18].

Daucus carota

White-flowered *Daucus carota*, a member of the Apiaceae family, is commonly known as wild carrot. The temperate regions of Southeast Asia and Europe are the original homes of this plant. Roots and seeds both play important roles in therapeutic formulations. Phytochemicals such as daucosol, xanthophylls, carotene, sesquiterpenoids, and daucoside can be found in this plant.45,46 The cardioprotective effects of *D carota* Linn's

aqueous extract in rats with isoproterenol-induced myocardial infarction were investigated by Muralidharan et al.⁴⁷ Transaminases, lipid peroxidases, cardiac protein, and lactate dehydrogenase (LDH) activity were measured to learn about cardioprotection.^[19]

Nerium oleander

The evergreen shrub *Nerium oleander* (NO), which belongs to the Apocynaceae family, is native to the eastern Mediterranean, northern America, and Anatolia. Experiments have demonstrated that NO concentrate can serve as a cardioprotective agent by increasing antioxidant components against oxidative stress. The 48 components employed in medicinal products are the leaves, flowers, roots, and bark of the roots. Phytochemicals present in this plant includes tannic acid, oleanolic acid, uzarigenin, neriodorein, oleandrose, karabin, neriodin, nerium D, nerium F, oleanolic acid, digitoxigenin, gitoxigenin, neriantin, odoroside, adyresin, ursolic acid, oleandrin, scopolin, scopoletin, oleandrogenin, 16-acetyl gitoxigenin, deacetyloleandrin, and dambonitol.⁴⁹ The cardioprotective efficacy of NO flowers was investigated by Gayathri et al.⁵⁰, who used isoproterenol to induce myocardial oxidative stress in rats.^[20]

Amaranthus viridis

While the Greeks termed *Amaranthus viridis* Linn the never-fading flower, the English name "slender amaranth" has stuck. This plant only lives for a year as an annual herb. Leaves, roots, and even entire plants can all be used for medicinal purposes. Quercetin and rutin are two examples of active phytoconstituents. Leucine, lysine, isoleucine, arginine, cystine, histidine, valine, phenylalanine, methionine, threonine, tryptophan, and tyrosine are only some of the amino acids found in this plant. *A. viridis* Linn has been shown to have cardioprotective effects in rat trials. Saravanan et al. administered 20 mg/kg body weight subcutaneously for 2 days straight of isoproterenol to produce MI in order to assess the cardioprotective capabilities of this plant. They found a wide range of enzyme levels in the heart. For 45 days, subjects were given oral doses of *Amaranthus viridis* at 100, 200, and 300 mg/kg of body weight. Heart enzyme levels were reduced in rat groups given the herb, demonstrating its cardioprotective properties. The most effective dose of *Amaranthus viridis* was shown to be 300 milligrammes per kilogramme of body weight. ^[21]

Ginkgo biloba

The Ginkgoaceae plant family includes *Ginkgo biloba* L. As one of the oldest seed plants still in existence, this plant has earned the nickname "living fossil." It has antioxidants like iron-based superoxide dismutase, ginkgolides, flavones glycosides, flavonol, ascorbic acid, diterpen lactones, catechin, sesquiterpenes, and flavonol. This plant has been credited with a wide range of therapeutic effects, including those of an antioxidant, antibacterial, anti-inflammatory, memory enhancer, hepatoprotective, depressive, anticoagulant, antiulcer, cytotoxic, antiaging, and antistress agent. This plant is well-liked because of its usefulness in medicine and food. Many

additional phytoconstituents, such as fatty acids, resins, essential oils, tannins, carotenoids, quercetin, and myricetin, are also present in *Ginkgo biloba*. The release of prostaglandins and nitric oxide from *Ginkgo biloba* extract was found to increase blood flow, avoid hypoxia, enhance blood rheology, cause platelet aggregation, and decrease capillary permeability.⁵⁸^[22]

Researchers have found cardioprotective effects in both *G. biloba* leaves and seeds. Rats with isoproterenol-induced cardiac necrosis were given *Ocimum sanctum* and *G. biloba* extract in Panda's study. Serum enzymes of rats with isoproterenol-induced cardiac necrosis were observed to be elevated in comparison to serum enzymes of normal rats. For 30 days, each rat was administered 100 mg of *G. biloba* and 50 and 75 mg of *O. sanctum* by mouth. The subcutaneous method was used to give 85 mg/kg of isoproterenol. On days 29 and 30, the serum enzymes level decreased dramatically. The cardioprotective effects of *Ocimum sanctum* (100 mg/kg body weight) and *Ginkgo biloba* (50 mg/kg body weight) were significantly greater than those of the combination of the two.^[23]

Terminalia arjuna

The average height of a *Terminalia arjuna* tree is between 60 and 80 feet. This flower is a member of the Combretaceae family. Its natural habitat is the sub-Himalayan regions of India. Its bark is greyish brown on the outside and bright red on the interior. Flavonoids, triterpenes, and tannins are only some of the phytoconstituents found in the *Arjuna* plant. The *Arjuna* plant, both its leaves and its bark, offer heart-protective properties. Arjunetin, polyphenols, beta-sitosterol, freidelin, arjunic acid, and triterpenes are all examples of phytoconstituents. We administered various doses of *T. arjuna* alcoholic extract orally to Wistar rats for 28 days to see whether or not the extract might protect the rats' hearts from isoproterenol-induced myocardial damage. After 4 weeks of therapy, isoproterenol (85 mg/kg body weight) was given subcutaneously to all treated animals, including the control group rats (normal untreated rats), for 2 consecutive days to induce myocardial damage. The study found that *T. arjuna* protected the myocardium against damage caused by isoproterenol-induced ischemia and reperfusion.³¹ Another study used a mouse model of DOX-induced cardiotoxicity to examine the potential cardioprotective effects of *T. arjuna* bark aqueous extract. *T. arjuna* aqueous extract was found to be a promising cardioprotective with possible cardioprotective effects, and the study found that it was also relatively safe. This plant's bark extract has cardioprotective properties and could be used in adjuvant chemotherapy for cancer patients.^[24]

Picrorhiza kurroa

High-quality medicinal plant *Picrorhiza kurroa*, belonging to the Scrophulariaceae family, is most well known by its Japanese name, "Kutki." Its primary distribution is from Kashmir to Kum in the northwestern Himalayas, while it is also found in the Indian states of Garhwal and Sikkim at elevations of 3,500 to 4,500 metres above sea level. Many chemical and pharmacological

studies have shed light on the promising role of P kurroa formulations, which have garnered a lot of attention to the Picrorhiza genus in recent years. Despite its bitter taste, Picrorhiza kurroa has several biological properties, including antioxidant, anticholestatic, anti-inflammatory, immunomodulatory, and hepatoprotective effects. This plant contains the chemicals berberine, kurrin, picrorhizetin, kutkisterol, sesquiterpene, apocynin, cathartic acid, and kutkin, among others. In a rat model of isoproterenol-induced myocardial infarction (MI), the cardioprotective effects of P kurroa ethanolic extract were studied. P kurroa extract showed significant cardioprotective effects at 80 mg/kg body weight. [25]

Salvia miltiorrhiza

The Labiatae plant family, of which Salvia miltiorrhiza is a member, is commonly used to treat and prevent cardiovascular problems. This plant has been utilised for thousands of years in Chinese traditional medicine, where it is revered as both a curative and a nutritious diet. Tablets, injection solutions, oral liquid, capsules, and slow-release formulations made from the rhizome and roots of this plant are widely used in Asia, Europe, and the United States for the treatment of cerebrovascular and cardiovascular illnesses.[26]

This plant's active components come from both lipid-soluble and water-soluble compounds. Tanshinone I, dihydrotanshinone I, tanshinone IIA, cryptotanshinone, and tanshinone IIB are all examples of the tanshinones, a class of lipophilic compounds.[67,68] Phenolic acids such as caffeic acid, danshenu, salvianolic acid A, salvianolic acid B, and rosmarinic acid are among the water-soluble components. Numerous biological effects, such as those against thrombosis, cancer, blood clotting, HIV, and coagulation, were demonstrated by the phenolic acids found in Salvia miltiorrhiza. The potential of S miltiorrhiza extract to prevent isoproterenol-induced myocardial infarction was studied in experimental rats. There was a decrease in left ventricular systolic pressure, an increase in serum glutamic oxaloacetic transaminase (SGOT), and an elevation in the ST-segment in rats given isoproterenol. Rats given isoproterenol had lower levels of antioxidant enzymes such as glutathione peroxidase and superoxide dismutase. A dose of either 29.76 or 59.52 mg/kg body weight of Salvia miltiorrhiza extract was given orally. The cardioprotective effects of Salvia miltiorrhiza extract against isoproterenol-induced myocardial infarction were demonstrated by the reversal of isoproterenol's effects on hemodynamic and biochemical variables. [27]

Tinospora cordifolia

For example, the climbing shrub Tinospora cordifolia (Wild) is known as "amrita" in Sanskrit and Hindi and as "amudamor chindle" in Tamil. It inhabits all of India's tropical regions. The Ayurvedic and tribal medical traditions place great value on the plant's roots and stem. Its extracts help with a wide variety of ailments, including jaundice, fever, diabetes, respiratory issues, rheumatism, and neurological diseases. T cordifolia has cardioprotective properties in its leaves, fruits, roots, and

stem. There are many different types of phytoconstituents, including tinosporin, tinosporic acid, tinosporol, giloin, giloinin, gilosterol, columbin, chasmanthin, palmarin, steroids, glycosides, sesquiterpenoids, diterpenoid lactones, and berberine. The potential of an alcoholic extract of T cordifolia for cardioprotection was studied in rats. In order to produce myocardial ischemia, a surgical blockage of the coronary artery was performed, followed by reperfusion for 4 hours. The results showed that compared to the control group, those who were treated with T cordifolia experienced a smaller infarct size and a lower level of lipid peroxide.[28]

Hydrocotyle asiatica

H asiatica contains the phytochemicals asiaticoside, tannic acid, and vallarin in its whole plant form. When given orally to rats for a week, an alcoholic extract of H asiatica has been studied for its potential cardioprotective effects against ischemia-reperfusion-induced myocardial infarction (100-1000 mg/kg body weight). There was a dose-response relationship. The infarct size of the extract-treated animals was significantly smaller than that of the normal, untreated rats.[29]

Bombax ceiba

The kapok tree, or red silk cotton, is a member of the Bombacaceae plant family and can be found in India, Sri Lanka, Myanmar, and Indonesia, among other places. Leaves, flowers, fruits, buds, barks, gums, seeds, and roots all have medicinal use. Tannins, flavonoids, -sitosterol, lupeol, naphthoquinone, n-triacontanol, and sesquiterpenoids can all be found in this plant. Cardioprotective activity of aqueous extract of B ceiba flowers against cardiotoxicity induced by adriamycin was reported by Patel et al. [30]

Centella asiatica

Asiatic pennywort, or Centella asiatica (L.), is a member of the Apiaceae family of plants. Sri Lanka, India, China, and Thailand are just few of the many Asian countries where it is commonly utilised as a medicinal herb or a gourmet vegetable. Tanning compounds, phenolic compounds, vallarine, sitosterol, hersaponin, hydrocotylin, bacogenin, triterpenes, asiaticoside, and asiatic acid are all present in this plant. Animals with adriamycin-induced cardiomyopathy were studied by Gnanapragasam et al, who looked into how C asiatica affected cardiac and antioxidant enzymes. Elevated levels of blood enzymes, such as aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, and creatine phosphokinase, indicated that adriamycin (2.5 mg/kg body weight intraperitoneal) induced myocardial injury. The enzyme activities were returned to normal after treatment with Centella asiatica (200 mg/kg body weight), demonstrating the plant's cardioprotective properties.[31]

Sonchus asper

Herbaceous plants in the genus Sonchus can be found all throughout Asia, Europe, and Africa. The amino acids, minerals, vitamins, and protein found in the aerial sections of Sonchus species aid in the prevention of abnormalities caused by malnutrition. Cancer, acute

icterohepatitis, inflammation, diarrhoea, snake venom poisoning, and rheumatism are only few of the conditions treated with decoctions or infusions made from these plants and given topically or orally. The phenols, flavonoids, flavonols, alkaloids, riboflavin, thiamine, niacin, tannins, sesquiterpenes, and proanthocyanidin found in this plant are beneficial to health.⁸⁰ The methanolic extract of *Sonchus asper* was investigated for its potential cardioprotective effects against oxidative damage generated by $KBrO_3$ in cardiac tissues of Sprague-Dawley male rats (Khan et al., 1981). They discovered that *S asper* methanolic extract (100 and 200 mg/kg body weight) significantly reduced oxidative stress in the heart caused by $KBrO_3$.^[32]

Mucuna pruriens

A.K.A. *Mucuna pruriens* (L.) DC. Originally from East India and China, where it earned its more familiar name of velvet bean. Tannins, iron, zinc, calcium, aluminium, steroids, tetrahydroisoquinoline, and glycosides are all chemical components. L-3,4-dihydroxy phenylalanine (L-dopa) is abundant in the seeds of the *mucuna pruriens* plant. L-DOPA is used to treat Parkinson's disease because it is a precursor to dopamine, a neurotransmitter. Rats were given *Naja sputatrix* (Javan spitting cobra) venom, and the cardioprotective effects of *M pruriens* were examined by Fung et al. Pretreatment with *Mucuna* extract reduced the cardiorespiratory and neuromuscular depressive action of *N sputatrix*. This may be related to the neutralisation of cobra venom toxins by antibodies elicited with *M pruriens* extract.^[33]

Andrographis paniculate

The Acanthaceae family includes the well-known medicinal plant *Andrographis paniculata* (AP). The Chinese, Indian, Bangladeshi, Pakistani, Thai, Hong Kong, Malaysian, Philippine, and Indonesian herbal medicine industries all rely heavily on it. In Ayurvedic and Unani medicine, it is one of the most widely utilised medicinal plants. The plant's chemical components include sodium, potassium, glycosides, flavonoids, tannic acid, diterpene lactone andrographolide, kalmeghin, 14-deoxy andrographolide, and 14-deoxy-11,12-didehydro andrographolide. By increasing antioxidant enzyme activities and decreasing cellular glutathione level, Woo et al. found that AP protected neonatal rat cardiomyocytes from reoxygenation/hypoxic damage.^[34]

Cichorium intybus

The Asteraceae family includes the *Cichorium intybus* species. Six species make up the genus, all of which can be found in Asia and Europe. Many different phytochemicals, including flavonoids, coumarins, vitamins, inulin, volatile chemicals, esculin, and lactones, are found in the cicory plant and are of medical value. In addition to emodine, triterpenoids, and anthracene, cicory also has phenolics, flavonoids, alkaloids, glycosides, saponins, tannins, fatty acids, and volatile oils. The cardioprotective effects of *C intybus* against ageing myocardium in albino rats were investigated by Nayeemunnisa et al., who gave the plant powder to the

animals for 30 days. Ageing, they concluded, raised taurine and glutathione levels in the heart while lowering catalase function. Cicory plant treatment reduced cardiac harm caused by oxidative stress and by the natural ageing process.^[35]

Sesbania grandiflora

The Fabaceae family includes *Sesbania grandiflora*. This plant was first discovered in Southeast Asia. Vitamins A and C, as well as riboflavin, nicotinic acid, amino acids, and minerals, make up 91 of the phytoconstituents ^[36]. Adult male Wistar-Kyoto rats were exposed to cigarette smoke for 90 days to cause oxidative damage, and Ramesh et al. studied the cardioprotective effect of *S grandiflora*. *S grandiflora* (1000 mg/kg body weight) aqueous suspension was administered orally to rats for 3 weeks, and the rats that had been exposed to cigarette smoke showed an increase in LDH activity alongside a decrease in catalase, glutathione peroxidase, glucose-6-phosphate dehydrogenase, glutathione-S-transferase, glutathione reductase, and cardiac superoxide dismutase activities. Smoke-induced oxidative damage to the heart can be prevented by taking *S grandiflora*, according to the study.^[37]

Many studies have looked into the effectiveness of natural and herbal therapies in preventing and treating cardiovascular disease ^[38]. This impetus comes from a few different sources. In example, the widely held perception that existing standard therapies are safe and effective has been compared to the potential for cost-efficient treatment. Many medicinal plants have been utilised to treat cardiovascular disease because of these reasons. Some plants have been used to treat cardiovascular disease; these include *Achillea arabica* (root, leaf, and stem), *Ageratum conyzoides* (leaves, stalks, and stems), *Artemisia absinthium* (leaves, stalks, and stems), *Chrysanthemum x morifolium* (flowers), and *Clerodendrum volubile* (leaves). Other members of the Lamiaceae family are also used for cardiovascular treatment ^[38] (Figure 1), including *Ballota glandulosissima* (Turkey) ^[39], *Clerodendrum volubile* (Nigeria) ^[40], *Ajuga integrifolia* (Ethiopia) ^[41], *Leonurus cardiaca* (Europe) ^[42], and *Pogostemon elsholtzioides* (Eastern Himalaya) ^[43]. *Terminalia arjuna*, *Ocimum sanctum* L., *Allium cepa* (onion), *Curcuma longa* L., *Commiphora mukul*, *Trigonella foenum-graecum* L., and *Allium sativum* L. (garlic) are just few of the land plants that have been shown to have cardioprotective properties ^[44]. Daucoside, sesquiterpenoids, carotene, xanthophylls, and daucosol are all bioactive chemicals found in *Daucus carota* that are utilised to treat cardiovascular disease ^[45]. Muralidharan et al. ^[46] measured cardiac enzymes like lactate dehydrogenase (LDH), cardiac protein, lipid peroxidases, and transaminases to assess cardiac protection. *Nerium oleander* (NO) concentrate has cardioprotective effects, as demonstrated in the trial ^[47]. Similarly, Gayathri et al. ^[48] looked into the cardioprotective properties of NO flowers in rats exposed to isoproterenol, which causes oxidative myocardial stress.

A study [49] aimed at determining whether or not *Amaranthus viridis* Linn had cardioprotective properties found that it reduced cardiac enzyme levels in plant-treated rats. Several studies have demonstrated a cardioprotective benefit of *Ginkgo biloba* seeds and leaves. Extracts of *Ginkgo biloba* and *Ocimum sanctum* were given to rats with isoproterenol-induced cardiac necrosis, and the results were compared by Panda and Naik [50]. Serum enzyme levels in healthy rats were found to be lower than those in rats with isoproterenol-induced cardiac necrosis. When compared to the administration of 100 mg/kg of *Ginkgo biloba* and 50 mg/kg of *Ocimum sanctum*, the administration of 50 mg/kg of *Ginkgo biloba* and 100 mg/kg of *Ocimum sanctum* showed significant protection against cardiovascular disease. Extracts from the roots, fruits, and stems of the *Tinospora cordifolia* plant were discovered to have cardioprotective effects. The cardioprotective effects of *Tinospora cordifolia* can be attributed to a number of different phytoconstituents [51, 52]. *Nerium oleander*, *Amaranthus viridis*, *Ginkgo biloba*, *Terminalia arjuna*, *Daucus carota*, *Picrorhiza kurroa*, *Salvia miltiorrhiza*, *Tinospora cordifolia*, *Mucuna pruriens*, *Hydrocotyle Asiatica*, *Bombax ceiba*, and *Andrographis paniculata* are some of the plants used to prevent CVD (Figure 1) [53].

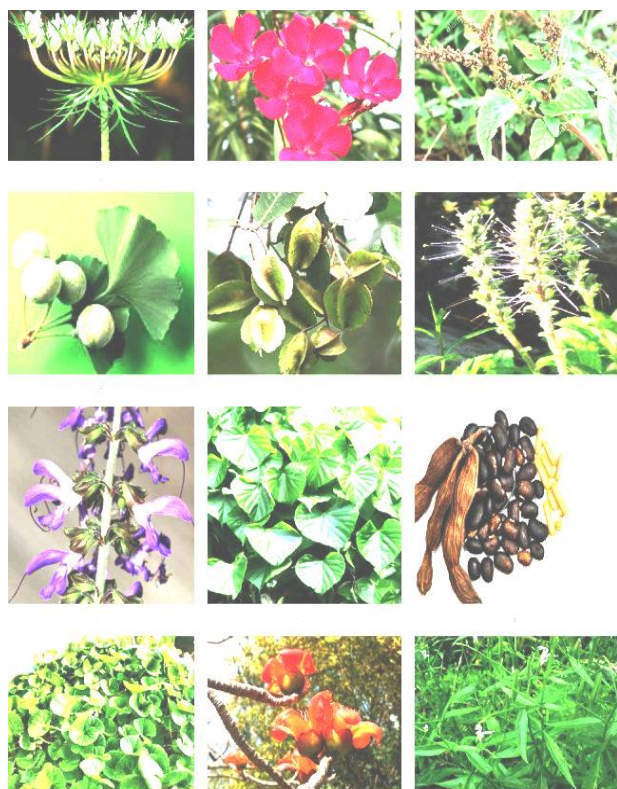


Figure 1: *Daucus carota*, *Nerium oleander*, *Amaranthus viridis*, *Ginkgo biloba*, *Terminalia arjuna*, *Picrorhiza kurroa*, *Salvia miltiorrhiza*, *Tinospora cordifolia*, *Mucuna pruriens*, *Hydrocotyle asiatica*, *Bombax ceiba*, and *Andrographis paniculata* are all examples of medicinal plants.

Numerous studies [54, 55] have established a connection between dietary variables and cardiovascular disease and metabolic syndrome. Health can be improved by replacing highly processed foods with whole foods such as legumes, vegetables, seeds, nuts, and fruits [56]. The diet is high in healthful components, including unsaturated fatty acids, minerals, fibres, carotenoids, phenolics, salt, and food additives. Coffee, tea, and other beverages are commonly utilised in the fight against cardiovascular disease [57]. Consumption of green tea has been linked to improved cardiovascular health in a variety of research settings [58]. Evidence that black tea has a greater effect than green tea in lowering cardiovascular disease risk is limited, however [59]. Consuming green tea for 14 weeks (1.7 mg catechin/day/mouse) accelerated the development of atherosclerosis and atherosclerosis in hypercholesterolemia apolipoprotein-deficient mice, as shown by Miura et al. [60]. Two weeks of treatment with green tea extract (3.5 g/liter) in the drinking water of hypertensive, stroke-prone rats reduced blood pressure [61].

Researchers reported that diabetic rats with cardiac failure who were given green tea (300 mg/kg body weight) for four weeks saw improvements in antioxidant protection and lipid profile [62]. Three cups of tea a day was associated with a reduced risk of cardiovascular disease in one research [63]. The leaves of the tea plant (*Camellia sinensis* L.) contain many phenolic chemicals. Caffeine levels are high [64]. Figure 2 [65] illustrates the phenolic compounds in tea that are used to treat cardiovascular disease; these include epicatechin (EC), epigallocatechin (EGC), epicatechin-3-gallate (ECG), and epigallocatechin-3-gallate (EGCG).

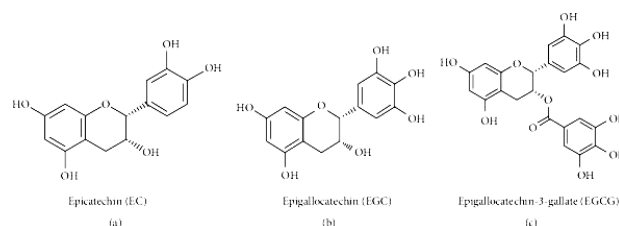


Figure 2: Epicatechin (a), epigallocatechin (b), epicatechin-3-gallate (ECG), and epigallocatechin-3-gallate (EGCG) are shown in their respective chemical structures.

Reduced risk of suicide, neurological disorders, and cardiovascular disease was attributed to coffee's caffeine [66]. It has been proven that consuming coffee or caffeine in moderation has no harmful effect on cardiovascular health [67, 68]. There was a common belief that coffee consumption raised one's chance of developing cardiovascular disease. Large-scale epidemiological studies, however, have found the opposite, showing that coffee actually protects against various types of cardiovascular disease [69]. Research shows that a 15% reduction in the risk of cardiovascular disease can be attained by drinking 35 cups of coffee everyday for a year.

The risk of cardiovascular disease is not increased by eating more.

In addition, regular coffee use (up to 15 cups per day) is associated with a lower mortality risk compared to abstaining from coffee altogether. People who have already suffered a heart attack or stroke do not face an increased risk of CVD, even with prolonged use. Patients with uncontrolled hypertension should limit their coffee intake [70]. Chlorogenic acid exists in coffee as three different isomers (Figure 3). [71] Coffee contains a number of bioactive compounds, including caffeine, diterpenes (such as cafestol and kahweol), and certain isomers of chlorogenic acid.

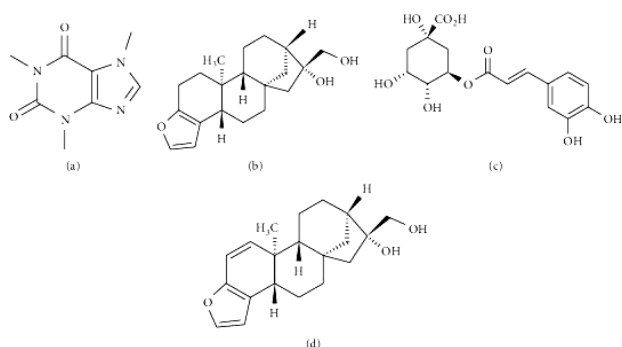


Figure 3: The chemical structure of bioactive chemicals in coffee is shown in A stimulant, in particular caffeine. Cafestol, (b). Lastly, chlorogenic acid (c). Kahweol

The polyphenolic structures of flavonoids, which are responsible for their bioactivity, include one heterocycle and two phenyl rings [74]. There is emerging evidence that flavonoids, a class of molecules with important biological activities, can offer protection against chronic diseases including cardiovascular disease [75]. Numerous studies, both epidemiological and experimental, have found a negative relationship between flavonoid consumption and the occurrence of cardiovascular disease. Flavonoids found in foods like fruits, vegetables, spices, and herbs have been shown to reduce the risk of cardiovascular disease [76].

Apples and onions, for example, are two examples of fruits and vegetables that are rich in flavonoids. Epidemiological research shows that flavonoids reduce the incidence of cardiovascular disease because of their antioxidant properties [77]. There is conclusive evidence that flavonoid consumption reduces the danger of cardiovascular disease and death in general. Flavonoids in tea were found to have a dose-dependent effect on lowering the risk of both fatal and nonfatal myocardial infarction. The risk of stroke was found to be greatly lowered by increasing flavonoid consumption, according to a subsequent study [78]. The cardiovascular system also benefits from flavonoids' capacity to increase vasodilation and regulate apoptotic processes in the endothelium [79]. Anti-inflammatory and antioxidant

effects on the cardiovascular system are utilised to treat cardiovascular disease with *Polygonum minus* extracts such as myricetin, quercetin, and methyl-flavonol.

Naringenin and apigenin-7-O-neohesperidoside are two of the flavonoids found in *Ajuga iva* that are utilised to treat cardiovascular disease [80]. The naringenin-7-O-glucoside in the traditional Chinese medicine *dracocephalum rupestre* protects against cardiovascular disease [81]. Figure 4: Quercetin, a compound found in tea, wine, apples, and onions and used to treat cardiovascular disease [82]. The risk of cardiovascular disease decreases with increased quercetin consumption. The hydroxyl group in the C and B rings of quercetin's structure may account for its high reactivity, making it the most potent antioxidant of all the flavonoids [83]. Polyphenols and flavonoids' antioxidant impact was formerly thought to be their principal mode of action [84].

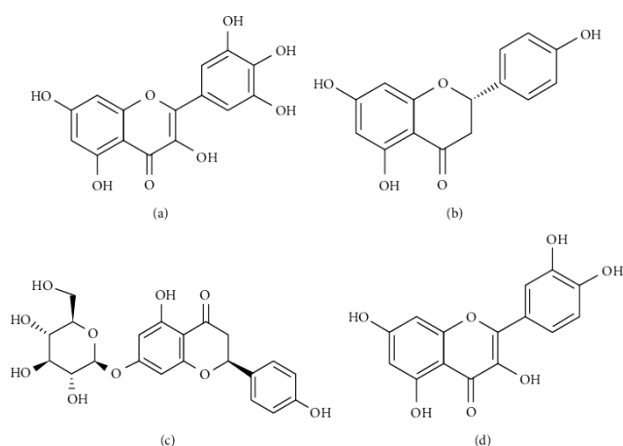


Figure 4: Composition of some flavonoids used to treat CVD. (a) Myricetin. (b) Naringenin. (c) Naringenin-7-O-glucoside. (d) Quercetin.

II. CONCLUSION

The cardio-protective effects of medicinal plants and their derivatives have been shown to be supported by a growing number of research. On the other hand, there is evidence indicating the possible adverse effects that some of the herbs may have. Researchers and members of the medical community need to work together to develop a more nuanced understanding of how medicinal plants and the compounds derived from them might be used in cardiovascular biology. The present manuscript is novel and exhaustive because it provides a detailed outline of the molecular basis of "herbal cardio-protection," active involvement of several herbs in ameliorating the cardiovascular status, adverse effects of medicinal plants, and clinical studies considering the use of phytotherapy, all on a single platform.

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