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A Brief Review on Cardioprotective Medicinal Plants

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ABSTRACT: Since the beginning of human evolution, Plants have been used to relieve human suffering since the dawn of humanity, and it has been documented that plants have been used for medicinal purposes for thousands of years. Natural bioactive compounds, called phytochemicals, are derived from medicinal plants, vegetables and fruits which are used to combat various diseases. Exploration of plant biodiversity for medicinal and pharmacological potentials is criticalcardiovascular abnormalities are treated with a number of substances derived from a variety of plant species. A number of bioactive compounds found in cardioprotective plants, such as antioxidants, flavonoids, anthocyanin, tannins, ellagic acid, terpenoids, carbohydrates, have been shown to improve cardioprotection and thus reduce the risk of cardiac disorders. The purpose of this review article is to present information on the use of medicinal plants, especially for the treatment of cardiac diseases, as well as to investigate the molecules/phytochemicals as plant secondary metabolites for their cardioprotective potential.

Key words: Cardioprotective, phytoconstituents, cardiotoxicity, myocardial infarction.

I. INTRODUCTION:

Heart attack, also called myocardial infarction (MI), and related complications are the leading causes of death worldwide. The use of antioxidants present in herbal plants is increasing as protecting agents against a number of cardiovascular diseases. by eliminating the generation of free radicals phytochemical agentsfrom natural sources have decreased the risks of heart disease and gained fundamental importance in modern drug systems[1] Cardioprotection include "all mechanisms and means that contribute to the preservation of the heart by reducing or even preventing myocardial damage". If this definition is accepted then Cardioprotection includes primary and secondary prevention of coronary heart diseases, cardiosurgical procedures, and thrombolysis in acute myocardial infraction. "Cardioprotection" as "Preservation of the heart" has also great theoretical implication[2]

Herbal medicine plays an important role in rural areas, and several locally produced medicines are still used as home remedies for different ailments. The increasing use of traditional therapies requires stronger scientific evidence for the underlying principles of therapies and for the efficacy of drugs. Herbal medicine remains the mainstay of around 75% to 80% of the world's population, mainly in developing countries, for primary health care due to better cultural acceptability, better compatibility with the human body and fewer side effects. Furthermore, traditional knowledge is the most affordable and accessible method available for the treatment of various diseases[3].

The accumulation of phytochemical, biological and clinical data during the last decade of the 20th century revealed that herbal remedies are the emerging option for the treatment of various ailments. Tulsi, Arjuna, Amla, Turmeric, Neem tree, Winter cherry are Medicinal herbs which are recognized to have cardioprotective potential. Large amount of important phytochemicals such as antioxidants, polyphenols, tannins, cardiac glycosides, saponin, ellagic acid, flavonoids, alkaloids identified from plant sources by scientists[1].

Biochemical reactions or signaling molecules produce some ROS (Reactive oxygen species) as by-products such as superoxide and hydrogen peroxide. superoxide, hydrogen peroxide, singlet oxygen, peroxyl radicals, hydroxyl radicals, and peroxynitrite are some of the antioxidants which protect cells against the damaging effects of ROS. When ROS-generating reactions are overly activated, pathological amounts of ROS are released to create an imbalance between antioxidants and ROS. Oxidative stress has been linked to cardiovascular diseases, diabetes, lung disease, cancer, and other degenerative diseases . Antioxidants present in herbal plants can safeguard

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patients against these diseases by increasing the total antioxidant defense system of human body. Many studies has proved the efficiency of herbal antioxidants[4].

Medicinal plants enriched with polyphenols, possessing free radical scavenging potential, may reduce the risk of heart diseases because of inverse relationship between cardiovascular diseases and intake of polyphenols[5]. Free radicals are reactive species generated in the body as a result of many endogenous (metabolic pathways) and exogenous (environmental pollution, pesticides, and exposure to radiations) source[6] The base of pathogenesis of cardiovascular diseases involves cell damage, necrosis, and apoptosis with accumulation of radicals and oxidative stress. accumulation of radicals is due to the influence of different environmental factors increase the level of free radicals and cells are unable to work efficiently against the free radicals[7]. Many antioxidants like Vitamins C and E and plant polyphenols are efficient tools in oxidative stress and cardiovascular disorders as potential therapeutic agents[8].

Herbal plants with cardioprotective activity:

Medicinal plants are used to prepare many drugs, but the Chemical constituents present on original plant material are more efficient with less side effects than their pharmaceutical derivatives. Variety of plants and their bioactive compound are well known for their minimal side effects, providing alternative therapeutic effect against cardiac diseases. Some of the plants having cardioprotective molecules/agents are given below, and the plants having cardioprotective effect against cardiotoxicity induced by various agents are given in Table.

Sr. No.	Common name	Plant Name	Family	Chemical constituents	uses	Studies	Result.	References.
1.	Tulsi	Ocimum sanctum	Lamiaceae	0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol phenolic compounds (antioxidants) such as cirsilineol, circimaritin, isothymusin, apigenin and rosameric acid, flavonoids,	Anticancer, Antioxidant activity, Antihypertensive, Antimicrobial, Antifertility, Antidiabetic, Antiulcer, Antipyretic, Antiarthritic, Anticoagulant.	Isoproterenol-induced cardiotoxicity in rats.	The present study pre- and co-treatment of Ocimum sanctum exhibited significant protection against ISO induced histopathological and biochemical canges. Our data indicates that Os may provide potential therapeutic value in treatment of MI.	[9,10]

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2.	Arjuna	Terminalia arjuna.	Combretaceae	Triterpenoids, Glycosides, Flavonoids, Tannins, Minerals, alkaloids, steroids, phenols.	Cardioprotective, Antiarrhythmic Cardiac,Stimulant, Antianginal Antiosteoporotic, Wound healing Anti-arthritic Anti-inflammatory, Antacid Antiulcerogenic. , aphrodisiac, antidysenteric, purgative and laxative.	Isoproterenol-Induced Cardiotoxicity in Rats.	The present study has demonstrated for the first time that oral administration of T. arjuna bark extract prophylactically as well as therapeutically not only reduced myocardial injury but also markedly improved cardiac function of ISO-induced CHF rats.	[11,12,13]
3.	Moonseed	Tinospora cardiofolia	Menispermaceae	alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic-compounds and polysaccharides Flavonoids, saponins, phytosterols, antioxidant.	Hypoglycemic, anti-inflammatory, hepatoprotective, immune-modulator activity, anti-oxidant, antitumour activity, Antineoplastic,antifertility activity, anti-oxidant, anti-hyperglycemic, anti-	isoprenaline-induced cardiotoxicity in rats.	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	[14,15,16]

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					neoplastic, anti-stress, anti-dote, anti-spasmodic, anti-pyretic, antiallergic, anti-leprotic, anti-inflammatory.		its ability to strengthen the myocardial membrane by its membrane stabilizing action.	
4.	Amla	Emblica officinal	Euphorbiaceae	vitamin C, minerals and amino acids. Antioxidant, tannoids, tannins and flavonoids.	Hypolipidemic, hypoglycemic, anti-inflammatory, hyperlipidemia and diabetes, cardioprotective.	isoproterenol-induced cardiotoxicity in rats.	The findings of present study demonstrate that E. officinalis significantly suppressed oxidative stress by improving endogenous antioxidant and restoring hemodynamic and left ventricular contractile function parameters impaired by ISP-induced MI. Preserved histoarchitecture of myocardium further evidenced myocardial salvaging activity of	[17, 18]

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							E. officinalis.	
5.	Oleander	Nerium oleander	Apocynaceae	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, oleandrigenin, 16-acetyl gitoxigenin, deacetyloleandrin, and dambonitol.	Cardioprotective, epilepsy, CHF.	isoproterenol-induced cardiotoxicity in rats.	cardioprotective potential of NO (Nerium oleander) flowers in rats using isoproterenol for the induction of myocardial oxidative stress and found good cardioprotective activity of this plant.	[19,20]
6.	Slender amaranth	Amaranthus viridis	Amarantaceae	Amino acids,Saponins, tannins, phenols, flavonoids, Alkaloids,cardiac glycosides, steroids, triterpenoids.	Anti-inflammatory, antihepatotoxic, anti-ulcer, hepatoprotective, anti-hyperglycemic, analgesic, anti-diabetic, cardioprotective.	isoproterenol-induced cardiotoxicity in rats.	The present finding have demonstrated that the cardioprotective effect of A. Viridis in ISO induced oxidative damage may be due to augmentation of the endogenous antioxidant and inhibition of lipid	[21,22]

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							peroxidation of membrane.	
7.	Maiden hair tree	Ginkgo biloba	Ginkgoaceae	flavones glycosides, flavonol, ascorbic acid, diterpen lactones, catechin, sesquiterpenes, resins, essential oils, tannins, carotenoids, quercetin, and myricetin.	g antioxidants, antimicrobial, anti-inflammatory, memory enhancer, hepatoprotective, antidepressant, anticoagulant, anti-ulcer, cytotoxic, antiaging, and antistress activitie	isoproterenol-induced cardiotoxicity in rats.	Present finding study the Ginko biloba phytosome exerts its cardioprotective effect by stabilizing the myocardial membrane. The membrane stabilizing activity of ginko biloba may due to augmentation of basal endogenous antioxidants, which in turn increase the myocardial antioxidant reserve and strengthen the defense mechanism operating in the myocardium.	[23]
8.	Roselle	Hibiscus sabdariffa	Malvaceae	Tannins, saponins, phenols,	Antihypertensive, antioxida	isoproterenol-induced cardiotoxic	Hibiscus sabdoriffa show a	[24,25]

				glycosides, alkaloids, and flavonoids.	nt, and cardiopro tective.	ity in rats.	potential in protecting cardiac cells from ISO induced MI proven by lowering the level of oxidative stressmark ers, normalizin g the GSH antioxidan t enzyme and the structural damage of heart tissue. The phenolic content in HPE(Poly phenol-rich extract)+ porobably trapped the free radicals and reduced the lipid peroxidati on formation induced by ISO.	
9.	pomegr anate	Carolus linnaeus	Lythrac eae	flavonoids, phenolic compound, ascorbic acid, citric acid, Ellagic acid, Anthocyanin , gallic acid.	Antimicr obial, cardiopro tective, Anti-inflamma tory, anti-obesity, anti-tumoral.	Doxorubici n-induced cardiotoxic ity in rats.	It can be concluded that whole fruit extract of pomegran ate has the ability to reduced stress in DOX-treated	[26]

							animals and show cardioprotective action.	
10.	Drumstick tree	Moringa oleifera M	Moringaceae	tannins, saponins, alkaloids, terpenes, carbohydrates, flavonoids, and cardiac glycosides.	Anticancer, anti-inflammatory, antipyretic, and cardioprotective.	Doxorubicin-induced cardiotoxicity in rats.	DOX-induced cardiotoxicity is related to oxidative stress. Antiproliferative, anti-initiation, and free radical scavenging properties of MO may boost myocardial integrity and attenuate the cardiac toxicity. MO has shown to be cardioprotective, which may be attributed to its potent antioxidant properties. The current study suggests that MO may be considered as a potentially useful candidate	[27]

							in combination with Dox to limit free radical-mediated heart injury.	
11.	Arogyapacha	Trichopus zeylanicus	Trichpodaceae	Alkaloids, glycosides, flavonoids, steroids, tannins, steroids, terpenoids.	Cardioprotective, Aphrodisiac.	isoproterenol-induced cardiotoxicity in rats.	Trichopus zeylanicus leaves proved to be effective in reducing the extent of myocardial damage, associated lipid peroxidation, thus maintaining, as suggested by biochemical indices, the structure and function of the myocardium.	[28]
12.	Bhuinimb/ Kalmegh	Andrographis paniculata	Acanthacea	Andrographolide, diterpenoids, flavonoids, quinic acid, xanthones, noriridoids, and andrographidoids A, B, C, D, and E , crocetin, crocin,	Cardioprotective, gastroprotective, antioxidant.	isoproterenol-induced cardiotoxicity in rats.	The ethanolic leaf extract of A. paniculate was used to evaluate the cardioprotective effect of this plant using its antioxidan	[29]

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							t properties as well as haemodyanamic, histopathologic and immunohistochemical changes.	
13.	Saffron	Crocus sativus	Iridaceae	Carotenoid compounds, crocetin, crocin, safranal, glucoside picrocrocin, anthocyanins, delphinidin, petunidin.	Cardioprotective, hypnotic, anxiolytic, anticancer.	isoproterenol-induced cardiotoxicity in rats.	The present study showed that pretreatment with saffron reduced histopathological changes in heart tissue and decreased ck-mb and LDH activities in serum saffron and safranal also reduce lipid peroxidation in heart tissue.	[30]
14.	Katuka	Picrorhiza kurroa	Scrofulariaceae	Sterols, glycosides, phenolic compounds, cucurbitacins ((triterpenoids), and iridoid glycosides.	Antioxidant, anti-inflammatory, and cardioprotective.	isoproterenol-induced cardiotoxicity in rats.	The present study demonstrate the cardioprotective effect of P. kurroa against ISP-induced myocardial injury and	[31]

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							validates the traditional claim. However, further studies are warranted to support its clinical use in ischemic heart disease.	
15.	Kokum	Garcinia indica	Clusiaceae	Garcinol, isoxanthochymol, xanthochymol, hydroxycitric acid, phenolic acids, flavonoids, benzophenones, isogarcinol, anthocyanins, and tannins.	Cardioprotective, antibacterial, hepatoprotective, antioxidant.	isoprenaline-induced cardiotoxicity in rats.	It may be concluded that garcina indica extract to ISO challenged rat augments endogenous antioxidant of rat heart, enhance scavenging of free radical and inhibit the lipid peroxidation membarane-, thereby salvaging the myocardium from the deleterious of ISO.	[32,33]
16.	Turmeric	Curcuma longa	Zingiberaceae	Curcumin, ar-turmerone, b-sesquiphellandrene, curcumenol, sesquiterpen	Cardioprotective, anti-inflammatory, antioxidant.	Doxorubicin-induced cardiotoxicity in rats.	Curcuma longa extract renders resiliency against doxorubicin	[34]

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				es, and phenolic constituents.			cardiotoxicity due to their contents of polyphenolic compound that might serve novel adjuvant therapy with doxorubicin.	
17.	Olive	Olea europaea	Oleaceae	Flavonoids, iridoids, secoiridoids, flavanones, benzoic acid derivatives, and triterpene.	Antidiabetic, anticancer, antimicrobial, and cardioprotective.	Doxorubicin-induced cardiotoxicity in rats.	Olea europaea extract were attributed mainly to major components oleuropein, phenolic antioxidant compound is effective against doxorubicin cardiotoxicity through suppression of oxidative and nitrosative stress.	[35]
18.	Winter cherry	Withania somnifera	Solanaceae	Alkaloids, steroids, glycosides, hentriacontane, dulcitol, withaniol, withananine, and flavonoids.	Anti-inflammatory, analgesic, immunomodulant, antirhematic, and cardiopro	isoprenaline-induced cardiotoxicity in rats.	W. somnifera leaves have the potential to be used as cardioprotective agents by	[36]

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					tective.		protecting cardiac tissue against oxidative damage.	
19.	Garden onion	Allium cepa	Alliaceae	Flavonoids, triterpenic acids, amino acids, steroids.	Cardioprotective, antibacterial, antioxidant, hypouricemic.	isoprenaline-induced cardiotoxicity in rats.	The aqueous extract of A. cepa400mg/kg was found to be cardioprotective against myocardial injury while A.cepa at 800mg/kg did not show significant cardioprotective activity. So, A. cepa might be effective within certain dose range only.	[37]
20.	Hatkhora,Satkara, Shatkora, Hatxora, Cabuyao	Citrus macroptera	Rutaceae	limonene, beta-caryophyllene, y, α-pinene, β-pinene, myrcene, α-phellandrene, and γ-terpinene monoterpene specially γ-elemene, linalool, terpinen-4-ol, α-terpineol, terpinolene,	Cardioprotective and Hepatoprotective, . Hypoglycemic, Antimicrobial, Antioxidant, Neuropharmacological.	isoprenaline-induced cardiotoxicity in rats.	Both C. macroptera peel and pulp extract conferred significant protection against ISO-induced MI in rats although the peel extract was superior. The	[38]

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				and geranyl acetate, polyphenols, flavonoids.			possible mechanisms underlying these effect include modulation of the levels of lipids and lipoprotein and improvement of the endogenous antioxidant enzyme system via inhibition of lipid peroxidation, The biochemical finding were further confirmed by histopathological examination.	
21.	Chamber Bitter, Gripweed, Shatterstone	Phyllanthus urinaria	Phyllanthaceae	lignans, tannins, flavonoids, phenolics, terpenoids, and other secondary metabolites.	anticancer, hepatoprotective, antidiabetic, antimicrobial, and cardioprotective.	Doxorubicin-induced cardiotoxicity in rats.	This study suggests that PU extract may serve as an alternative oxidant for prevention of DOX cadiotoxicity. Further studies should identify the active constituents of PU	[39]

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							for pharmacologic evaluation and potential ROS-related therapeutic implication.	
22.	Water hyssop, Brahmi, Herb grass, Indian pennywort	Bacopa monnieri	Scrophulariaceae	Alkaloids brahmine,nicotine,bacosideA and B,Saponins A,Band C, triterpenoid saponins, glutamic acid, betulinic acid, stigmasterol.	Anxiety, epilepsy, Antidepressant, Anxiolytics, anticonvulsant,Antimicrobial, Analgesic, Anti-inflammatory, cardioprotective.	Myocardial ischemia/reperfusion injury in rats.	Bacopa monnieri improve myocardial function following ischemia/perfusion injury through recovery of coronary blood flow, contractile force and decrease in infract size. Thus this may leads to novel cardioprotectant strategy.	[40]
23.	Cactus	cactus grandiflorus	Cactaceae	Alkaloids, Flavonoids, phenolic, sterols, saponins, carbohydrates, Protein, amino acids, tannins,polyphenols.	Antimicrobial, Antitumorigenic, Diabetes, Angina pectoris, heart weakness, Antihypertensive.	Doxorubicin-induced cardiotoxicity in rats.	In the present study, doxorubicin alone treatment to a great extent reduced the levels of antioxidative enzymes i.e. SOD and CAT.	[41]

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							Treatment with Cactus grandiflorus mother tincture can improve the deficient antioxidant status of heart. This preparation also has no deleterious effect on liver and kidney in both doses. Its beneficial effect in doxorubicin cancer therapy should be evaluated in further studies.	
24.	Neem tree	Azadirachta indica	Meliaceae	Reducing sugar, tannins, flavonoids, steroids, terpenoids, glycosides, and alkaloid.	Cardioprotective, chemopreventive, antiplasmodial, anti-inflammatory	isoprenaline-induced cardiotoxicity in rats.	This study demonstrates the cardioprotective effect of Azadiricta indica A Juss. Leaf extract was found to be most effective in the functional recovery of the heart and restoration of biochemical and histopatho	[42]

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							logical alteration.	
25.	Malabar plum, Java plum, Black plum	Syzygium cumini	Myrtaceae	Anthocyanins, ellagic acid, glucoside, kaemferol isoquercetin, alkaloids, myrecetin, glycosides, and jambosin.	Antidiabetic, antioxidant, and cardioprotective.	Doxorubicin-induced cardiotoxicity in rats.	The result show that syzygium cumini seed have potent antioxidant as well as cardioprotective activity. A further research on syzygium cumini seed against doxorubicin induced rat in progress.	[43]
26.	Hairy fig	Ficus hispida	Moraceae	Alkaloids, terpenes, saponins, glycosides, mucilage, gums, flavonoids, phenols, sterols, amino acids, b-amyrine acetate, protein, carbohydrates, n-triacontanol, lupeol acetate, b-sitosterol	Cardioprotective, antipyretic, hepatoprotective, anti-inflammatory	Doxorubicin-induced cardiotoxicity in rats.	Doxorubicin exposure result in pronounced oxidative stress and administration of ficus racemose stem bark extract protects the heart by scavenging free radicals.	[44]
27.	African tulip tree	Spathodea campanulata	Bignoniaceae	Saponin, flavonoids, steroid, alkaloids, glycoside, tannin, phenol, phlobatanin, terpenoids,	Antimalarial, anti-HIV, hypoglycemic, cardioprotective.	isoproterenol-induced cardiotoxicity in rats.	The present study clearly showed EEBSC modulated most of the	[45]

				and anthraquinon.			biochemical and histopathological indicators which were maintained to normal status in isoproterenol rats, suggesting the beneficial action of EEBSC as a cardioprotective agent.	
28.	Marking nut	Semecarpus anacardium	Anacardiaceae	Bhilwanols, phenolic compounds, biflavonoids, sterols, glycosides, ursuhenol, anacardoside, semecarpetin, nallaflavanone, jeediflavanone, semecarpuflavanone.	Cardioprotective, antioxidant, anticancer, antidiabetic.	isoproterenol-induced cardiotoxicity in rats.	The present study it may concluded that the both the high dose low dose posseses good cardioprotective activity against isoproterenol induced myocardial necrosis in rats, also elucidate the active constituents responsible for the said effect with extensive evaluation	[46]

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							of histopathological and ultra structural changes.	

II. CONCLUSION

Presently there is an increasing interest worldwide in herbal medicines accompanied with increased laboratory investigations into the pharmacological properties of the bioactive ingredients and their ability to treat various diseases. The present review has accentuate on the effects of cardiovascular disease, the cardioprotective phytoconstituents present in the plants, the various biochemical estimations and several in-vitro, in-vivo and human studies carried out in the papers .The brief survey of literature evidences us that the traditional medicinal plants have no known side effects and the presence of cardioprotective bioactive compounds in plant extracts.

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