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Review article

Indian Plants with Cardioprotective Activity – A Review

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ABSTRACT
Cardio-protection includes" all mechanism and means that contribute to the preservation of the heart by reducing or even preventing Myocardial damage. Cardiovascular disease (CVD) remains the principle cause of death in both developed and developing countries. It may present as a typical heart attack, a sudden death or it may be detected at an advanced stage and be described as a silent infarct. CVD includes high blood pressure, coronary heart disease, congestive heart failure, stroke and accounts Myocardial infarction is the interruption of blood supply to part of the heart, causing heart cells to die, commonly due to blockage of coronary artery. Herbal drugs are known to exhibit creditable medicinal properties for the treatment of heart ailments and need to be explored to identify their potential application in prevention and therapy of human ailments. Cardio-vascular disease remains a leading cause of death in India. Therefore, finding ways to reduce the mortality of cardiovascular disease remains an important health goal. This review deals with medicinal plants possessing cardio-protective and cardio tonic activity. Cardiovascular disease is the number one cause of death globally and is projected to remain the leading cause of death. This review work explains chemical and pharmacological status of various cardio-protective plants including phyto constituents responsible for cardio-protection, extract employed, dosage, pharmacological screening model and mechanism involved in cardio-protection. This review work definitely helps in enlisting the Indian plants having cardioprotective activity.

Key words: Cardioprotective, Review, Myocardial infarction, Cardiovascular disease.

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INTRODUCTION

The medicinal plants are potential sources of drugs as they are rich in secondary metabolites and essential oils of therapeutic importance.[1] Uses of medicinal plants in various ailments are due to being economical, effective, their ease availability and due to their safety.[2] Because of these advantages the use of medicinal plants has been widely increased by the traditional medical practitioners in their day to day practice.[3] Foods are used commonly to meet our nutritional needs. However, foods obtained by plants contain a wide range of non- nutrient phytochemicals that are synthesized by plants for their own defence and for other biological functions. When we ingest these plant foods to meet our nutritional needs, we also ingest a wide variety of these non-nutrient phytochemicals. These phytochemicals have the potential for preventing chronic diseases and also non-toxic.[4] Cardiovascular disease is the number one cause of death globally and is projected to remain the leading cause of death. As many as 1.4 million children are suffering from heart related diseases in Pakistan and some 8,000 need heart surgeries annually, but out of them only 1,200 are operated upon. (Sixth "Biennial International Conference," organized by the Pakistan Society of Cardiovascular and Thoracic Surgeries). Free radicals play deleterious role to body established ischemia. Presence of various antioxidant compounds in fruits and vegetables, for example, vitamins C and E, b-carotene and polyphenolics have been associated with decreased risks of several chronic diseases, such as coronary heart disease and some cancers. Antioxidants scavenging the free radicals and protect the body. There is inverse relationship between intake of polyphenols and heart diseases.[5]

There is a large and increasing global burden of cardiovascular disease. Approximately 14 million individuals died of cardiovascular disease in 1990, and this is projected to rise to about 25 million by 2020.[6] The global burden of disease due to cardiovascular diseases (CVDs) is escalating, principally due to a sharp rise in the developing countries which are experiencing rapid health transition.[7] The continuous increase in incidences of cardiovascular disease is a manifestation of chronic poor diet and lifestyle choices, which lead to diabetes and obesity.[8]

More than 2000 plants have been listed in the Traditional (Herbal/Alternative) systems of medicine and some of these are providing comprehensive relief to the people suffering from cardio-vascular diseases, specially "hyperlipidemia" and "ischemic heart disease". WHO reports indicate that around eighty percent of the global population still relies on botanical drugs and several herbal medicines have advanced to clinical use in modern times. The use of Western medicinal drugs for the treatment of hypertension, congestive heart failure and post myocardial infarction are widely accepted.[9]

Various phytoconstituents from plants were responsible for cardioprotective activity. Refer Table 1.[10-19]

METHODS EMPLOYED

Pharmacology of cardioprotective plants: Phytoconstituents reported in cardioprotective plants significantly prevented the altered biochemical variation such as marker enzymes serum glutamate- pyruvate transaminase (SGPT) or alanine transaminase (ALT), serum glutamate oxaloacetate transaminase (SGOT) or aspartate transaminase (AST), creatinephosphokinase (CPK), alkaline phosphatise (ALP), lactate dehydrogenase (LDH), lipid profile including low density lipoprotein (LDL), VLDL (very low density lipoprotein), triglycerides (TGs), high density lipoprotein (HDL), total cholesterol and antioxidant parameters including Superoxide dismutase (SOD), glutathione (GSH), catalase (CAT), Glutathione peroxidase (GPx), MDA (malonaldialdehyde) and glutathione reductase (GR) come to near normal status. Cardioprotective activity was evaluated using various pharmacological screening models like isoprenaline induced myocardial necrosis in rats, doxorubicin (DOX) induced cardiotoxicity in albino rats, cyclophosphamide induced oxidative myocardial injury in a rat model, ischemia-reperfusion-induced myocardial infarction in albino rats, cigarette Smoke- exposed Rats, adriamycin-induced cardio Myopathy in rats etc.[20-38]

Table 1: Various phytoconstituents from plants were responsible for cardioprotective activity

Phytoconstituents	Plant name	Family
Allicin, sulphur compounds[10]	Allium sativum	Liliaceae
Flavonoids, carotenoids[11]	Anacardiumoccidentale	Anacardiaceae
Cardiac glycosides[12]	Antiaristoxicaria	Moraceae
Saponins-Shatavarins I–IV[13]	Asparagus racemosus	Asparagaceae
Triterpenes[14]	Ganodermalucidum	Ganodermataceae
Triterpenoid[15]	Leptadeniapyrotechnica	Asclepiadaceae
Cardiac glycosides[16]	Digitalis purpurea	Scrophulariaceae
Alkaloidal constituents, including berberine; bitter principles, including columbin, chasmanthin, palmarin and tinosporon, tinosporic acid and tinosporol[17]	Tinosporacordifolia	Menispermaceae
Caffeic acid[18]	Raphanussativus	Cruciferae
Protein19	Euryale ferox	Nymphaeaceae

Table 2: Pharmacological status of some cardioprotective plants has been mentioned below

Plant/Family name	Dose administered mg/kg	Extract	*In vitro/in vivo* model	Mechanism involved and observation
Bacopamonnieri, Scrophulariaceae	50, 100, 150, 200	hydroalcoholic	Isoproterenol induced myocardial necrosis in rats	Antioxidant components (Bacosides A and B) caused significant rise in endogenous antioxidants (SOD, CAT, GSH) and decrease in MDA
Cocosnucifera,Palmae	100	Water	Isoproterenol induced myocardial infarction in albino rats	Decrease in serum enzymes (CPK, LDH, SGOT, SGPT)and very little myocardial damage in isoproterenol treated rats fed tender coconut water
Cichoriumintybus, Compositae	500	Aqueous	Ageing myocardium of albino rats	*Cichorium* extract was found to ameliorate the age induced injury and offered protection to the heart from oxidative damage and also found to decreases erum enzymes
Colebrookeaoppositifolia, Lamiaceae	250,500	Methanolic	Doxorubicin(DOX) induced cardiotoxicity in albino rats	The study of lipid peroxidation and anti-oxidant enzymes reveled that the malondialdehyde level was decreased,GS, SOD and CAT levels were significantly rised in *C.oppositifolia* extractt reated group
Curcumalonga, Zingiberaceae	100	hydroalcoholic	Isoproterenol induced hemodynamic, biochemical and histopathological alternations in rats	Administration of hydroalcoholice xtract causes myocardial adaptation by augmenting endogenous antioxidants and protects rat hearts from decline in cardiac function and oxidative stress associated with isoproterenol induced myocardial injury
Cynodondactylon, Poaceae	25,50,100,200 µg/ẁl	hydroalcoholic	Ischemia/reperfusion-(I/R)induced arrhythmias	*C.dactylon* produce protective effects against I/R-induced arrhythmias in isolated rat hearts probably by increase in the myocardial contractility and as a result by improvement of Hemodynamic factors

Daucuscarota, Umbeliferae	250,500	Aqueous	Isoproterenol induced myocardial infarction in albino rats	Aqueous extract showed a decrease in serum as partate Transaminase (AST), alanine transaminase (ALT), lipidperoxidase, lactate dehydrogenase levels and cardiac total protein lipid peroxidase, and lactate dehydrogenase
Dracocephalum moldavica, Labiatae	25-200 µg/ŵl	Total extract (Methanol-water)	Ischemia/Reperfusion induced arrhythmias and infarcts izein the isolated rat heart	Total extract of *D.moldavica* causedasignificantreductioninthenumberofventriculartachycardia(VT), totalventricularectopicbeats(VEBs) and VT duration in ischemicandreperfusionperiods
Embelicaribes, Myrsinaceae	100	Aqueous	Isoproterenol induced myocardial infarction in albino rats	Pretreatment with an a queous extract of E.ribes, significantly reduced the elevated markerenzym elevels in serum and heart homogenates and also enhances the antioxidant defence system against isoproterenol-induced myocardial infarction
Ficushispida, Moraceae	400 mg/kg	Methanolic	Cyclophosphamide induced oxidative myocardial injury in a rat model	Methanolic extract of F.hispida protected the cardiac tissue by scavenging the free radicals, which was proved by normalization of biochemical parameters
Tribulusterrestris,Zygophyllaceae	250	Hydroalcoholic	Isoproterenolinducedmyocardialinfarctionin rats	*T.terrestris* hydroalcoholicextractdecreasedtheleakage of CK-MBandLDHenzymesfrommyocardium.Presenceofantioxidantconstituents (flavanoids)intheextractmightberesponsibleforitscardioprotection
Trichopuszeylanicus, Trichopodaceae	500	Ethanolic	Isoproterenolinducedmyocardialinfarctionin rats	Significant decline was shown in the activities of cardiac markers such as ALT, AST, LDH and CK in the heart of acute Is oproterenol-treatedrats
Withaniasomnifera, Solanaceae	300	Ethanolic	Doxorubicin-induced cardiotoxicityin rats	Significantdecreaseinserumenzymes
Zingiberofficinale,Zingiberaceae	200	Ethanolic	Isoproterenol induced oxidative myocardial necrosis in rats	Significant decline was shown in the activities of cardiac markers such as ALT, AST, LDH and CK
Cinnamomumtamala Lauraceae	200 and 400	Ethanolic extract	Doxorubicin-induced cardiotoxicity in rats	significant cardio protective activity by lowering the levels of serum marker enzymes and lipid peroxidation and elevated the levels of catalase.
Garciniaindica	250 and 500	aqueous extract	Isoproterenol induced oxidative myocardial lnecrosis in rats	Cardioprotective effect was also confirmed by histopathology of hearts which showed less necrosis in extract treated rats when compared to untreated rats of toxic control group.
PithecellobiumDulce	200	aqueous and ethanolic extract	Isoproterenol induced oxidative myocardial necrosis in rats	Aqueous and ethanolic extracts of P. dulce fruit peel reverses the cardiac damage induced by isoproterenol.

CONCLUSION

Secondary metabolites like carotenoids, triterpenes, flavonoids, cardiac glycosides, alkaloids saponins, polyphenols, terpenoids, fatty acids *etc* were responsible for cardio-protective activity at a particular dose which was evaluated using appropriate pharmacological screening approach.

REFERENCES

1. Jay R, Umang H, Divyash K, Ankur K. Cardio-protective Effect of Methanolic extract of Syzygium Aromaticum on Isoproterenol Induced Myocardial Infarction in Rat. Asian Journal of Pharmacology and Toxicology. 2014;02(04):01-6.
2. Vikrant A, Vivek KG. Chemistry & pharmacology of plantcardioprotectives: A review. IJPSR. 2011;2(5):1156-67.
3. Parasuraman S, Thing GS, Dhanaraj SA. Polyherbal formulation: Concept of ayurveda. Phcog Rev. 2014;8(16):73-80. http://dx.doi.org/10.4103/0973-7847.134229; PMid:25125878 PMCid:PMC4127824.
4. Rao BN. Bioactive phytochemicals in Indian foods and their potential in health promotion and disease prevention. Asia Pacific J Clin Nutr. 2003;12(1):9-22. PMid:12737006.
5. Nuutila AM, Puupponen-PimiaR, Aarni M, Oksman-Caldentey KM. Caparison of antioxidant activities of onion and garlic extracts by inhibition of lipid peroxidation and radical scavenging activity. Food Chemistry. 2003;81(4):485-93. http://dx.doi.org/10.1016/S0308-8146(02)00476-4.
6. Neal B, Chapman N and Patel A. Managing the global burden of cardiovascular disease. European Heart Journal Supplements. 2002;4:F2-F6. http://dx.doi.org/10.1016/S1520-765X(02)90022-2.
7. Reddy SK. Cardiovascular diseases in the developing countries: Dimensions, determinants, dynamics and directions for public health action. Public Health Nutrition. 2002;5(1a):231-7. http://dx.doi.org/10.1079/PHN2001298; PMid:12027289.
8. Das DK. Natural Products and Healthy Heart. J Cardiovasc Pharmacol. 2009;54(5):366-8. http://dx.doi.org/10.1097/FJC.0b013e3181c6eeef.
9. Mahmood ZA, Mohammad S, Mahmood SBZ, Karim MA. Herbal treatment for cardiovascular disease the evidence based therapy. Pak J Pharm Sci. 2010;23(1):119-24. PMid:20067878
10. Isensee H, Rietz B, Jacob R. Cardioprotective actions of garlic (Allium sativum). Arzneimittelforschung.1993;43(2):94-98. ; PMid:8457243.
11. Trox J, Vadivel V, Vetter W, Stuetz W, Scherbaum V, Gola U, *et al.* Bioactive compounds in cashew nut (Anacardium occidentale L.) kernels: effect of different shelling methods. Journal of Agricultural and Food Chemistry. 2010;58(9):5341-6. http://dx.doi.org/10.1021/jf904580k ; PMid:20387832.
12. Shi LS, Liao YR, Su MJ, Lee A, Kuo PC, Damu AJ, *et al.* Cardiac Glycosides from Antiaristoxicaria with Potent Cardiotonic Activity. J Nat Prod. 2010;73(7):1214-22. http://dx.doi.org/10.1021/np9005212 ; PMid:20553004 PMCid:PMC2917517.
13. Bopana N, Saxena S. Asparagus racemosus- Ethnopharmacological evaluation and conservation needs. Journal of Ethnopharmacology. 2007;110(1):1-5. http://dx.doi.org/10.1016/j.jep.2007.01.001 ; PMid:17240097.
14. Sheena N, Lakshmi B, Janardhanan KK. Therapeutic potential of Ganodermalucidum. Natural Product Radiance. 2005;4:382-6.
15. Jain GC, Jhalani S, Agarwal S, Jain K. Hypolipidemic and Antiatherosclerotic Effect of Leptadenia pyrotechnica Extract in Cholesterol Fed Rabbits. Asian J Exp Sci. 2007;21(1):115-22.
16. Ziberna L, Lunder M, Moze S, Vanzo A, Drevensek G. Cardioprotective effects of bilberry extract on ischemia-reperfusion-induced injury in isolated rat heart. BMC Pharmacolog. 2009;12;9(2):A55.
17. Rao PR, Kumar VK, Viswanath RK, Subbaraju GV. Cardioprotective activity of alcoholic extract of Tinosporacordifolia in ischemia-reperfusion induced myocardial infarction in rats. Biol Pharm Bull. 2005;28(12):2319-22. http://dx.doi.org/10.1248/bpb.28.2319.
18. Rifat-uz-Zaman. Study of Cardioprotective activity of Raphanussativus in rabbits, Pakistan Journal of Biological Sciences. 2004;7(5):843-7. http://dx.doi.org/10.3923/pjbs.2004.843.847.
19. Das S, Der P, Raychaudhuri U, Maulik N, Das DK. The effect of Euryale ferox (Makhana), an herb of aquatic origin, on myocardial ischemic reperfusion injury. Molecular and Cellular Biochemistry. 2006;289(1-2):55-63. http://dx.doi.org/10.1007/s11010-006-9147-1; PMid:16628469.
20. Mohanty IR, Arya DS, Gupta SK. Dietary Curcuma longa protects myocardium against isoproterenol induced hemodynamic, biochemical and histopathological alternations in rats. International Journal of Applied Research in Natural Products. 2009;1(4):19-28.
21. Najafi M, Nazemiyeh H, Ghavimi H, Gharakhani A, Garjani A. Effects of hydroalcoholic extract of Cynodondactylon (L.) pers. on ischemia/reperfusion-induced arrhythmias. DARU. 2008;16(4):233-8.
22. Muralidharan P, Balamurugan G, Kumar P. Inotropic and cardioprotective effects of Daucuscarota Linn. on isoproterenol-induced myocardial infarction. Bangladesh J Pharmacol. 2008;3(2):74-9. http://dx.doi.org/10.3329/bjp.v3i2.849.
23. Najafi M, Ghasemian E, Fathiazad F, Garjani A. Effects of Total Extract of Dracocephalummoldavica on Ischemia/Reperfusion Induced Arrhythmias and Infarct Size in the Isolated Rat Heart. Iranian Journal of Basic Medical Sciences. 2009;11(4):229-35.
24. Bhandari U, Ansari MN, Islam F. Cardioprotective effect of aqueous extract of Embelicaribes fruits against Isoproterenol induced myocardial infarction in albino rats. Indian Journal of Experimental Biology. 2008;46(1):35-40. PMid:18697569.
25. Shanmugarajan TS, Arunsundar M, Somasundaram I, Krishnakumar E, Sivaraman D, Ravichandiran V. Cardioprotective effect of Ficushispidal on Cyclophosphamide induced oxidative myocardial injury in a rat model. International Journal of Pharmacology. 2008;1:1-10.
26. Wei AN, Jing Y, Ying AO. Metallothionein mediates cardioprotection of isoliquiritigenin against ischemia- reperfusion through JAK2/STAT3 activation. Acta Pharmacologica Sinica. 2006;27(11):1431-7. http://dx.doi.org/10.1111/j.1745-7254.2006.00419.x ; PMid:17049118.
27. Karthikeyan K, Bai BRS, Devaraj SN. Efficacy of Grape Seed Proanthocyanidins on Cardioprotection During Isoproterenol-induced Myocardial Injury in Rats. Journal of Cardiovascular Pharmacology. 2009;53(2):109-15. http://dx.doi.org/10.1097/FJC.0b013e3181970c01; PMid:19188839.
28. Pragada RR, Veeravalli KK, Chowdary KPR, Routhu KV. Cardioprotective activity of Hydrocotyleasiatica L. in ischemia- reperfusion induced myocardial infarction in rats. Journal of Ethnopharmacology. 2004;93(1):105-8. http://dx.doi.org/10.1016/j.jep.2004.03.025 ; PMid:15182913.
29. Ojha S, Nandave M, Kumari S, Arya DS. Cardioprotection by Inularacemosa in experimental model of ischemic reperfusion injury. Indian Journal of Experimental Biology. 2010;48:918-24. PMid:21506500.
30. Fard MH, Naseh G, Bodhankar SL, Dikshit M. Cardioprotective Effect of Lagenariasiceraria (Molina) Standley (Cucurbitaceae) Fruit Juice on Doxorubicin Induced Cardiotoxicity in Rats. American Journal of Pharmacology and Toxicology. 2010;5(2):103-8. http://dx.doi.org/10.3844/ajptsp.2010.103.108.
31. Prabhu S, Jainu M, Sabitha KE, Devi CSS. Cardioprotective Effect of Mangiferin on Isoproterenol induced myocardial infarction in rats. Indian Journal of Experimental Biology. 2006;44(3):209-15. PMid:16538859.
32. Nandave M, Ojha SK, Joshi S, Kumari S, Arya DS. Moringaoleifera Leaf Extract Prevents Isoproterenol-Induced Myocardial Damage in Rats: Evidence for an Antioxidant, Antiperoxidative, and Cardioprotective Intervention. Journal of Medicinal Food. 2009;12(1):47-55. http://dx.doi.org/10.1089/jmf.2007.0563; PMid:19298195.
33. Nivethetha M, Jayasri J, Brindha P. Effects of Muntingiacalabura L. on isoproterenol-induced myocardial infarction. Singapore Med J. 2009;50(3):300-2. PMid:19352575
34. Krishnamoorthy G, Shabi MM, Ravindhran D, Uthrapathy S, Rajamanickam VG, Dubey GP. Nardostachysjatamansi: cardioprotective and hypolipidemic Herb, Journal of Pharmacy Research. 2009;2(4):574-8.
35. Sharma M, Kishore K, Gupta SK, Joshi S, Arya DS. Cardioprotective potential of Ocimum sanctum in isoproterenol induced myocardial infarction in rats. Molecular and Cellular Biochemistry. 2001;225(1-2):75-83. http://dx.doi.org/10.1023/A:1012220908636 ; PMid:11716367.
36. D Rajaprabhu, Rajesh R, Jeyakumar R, Buddhan S, Ganesan B, Anandan R. Protective effect of Picrorhizakurroa on antioxidant defense status in adriamycin-induced cardiomyopathy in rats. Journal of Medicinal Plant Research. 2007;1(4):80-5.

37. Arya DS, Arora S, Malik S, Nepal S, Kumari S, Ojha S. Effect of Piper betle on cardiac function, marker enzymes, and oxidative stress in isoproterenol-induced cardiotoxicity in rats. Toxicology Mechanisms and Methods. 2010;20(9):564-71. http://dx.doi.org/10.3109/15376516.2010.514962 ; PMid:20846025.
38. Rajendran R, Basha NS. Cardioprotective effect of ethanol extract of stem-bark and stem-wood of Premnaserratifolia Lin., (Verbenaceae). Research J Pharm and Tech. 2008;1(4):487-91.
39. Nagaraju, Vidhyadhara, Aruna K, Vikas S, Suryanarayana D. Evaluation of cardioprotective activity of Ethanolic extract of dried leaves of Cinnamomumtamala in rats. International Journal of Biomedical and Advance Research. 2016;7(4):181-6.
40. Karunakar H, Dhruv P, Kreethi V. Evaluation ofcardioprotective activity of aqueous extract of garciniaindicalinn. fruit extract. Asian J Pharm Clin Res. 2015;8(2):107-12.
41. Pakutharivu T, Anitha A, Usha V, Sharmila S, Chitra S. Cardioprotective Activity of Pithecellobium Dulce Fruit Peel on Isoproterenol-Induced Myocardial Infarction in Rats. Int J Pharm Sci. 2015;30(1):133-6.

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SUMMARY

- Secondary metabolites like carotenoids, triterpenes, flavonoids, cardiac glycosides, alkaloids saponins, polyphenols, terpenoids, fatty acids etc were responsible for cardioprotective activity at a particular dose which was evaluated using appropriate pharmacological screening approach.