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 cardioprotective 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. Uses of medicinal plants in various ailments are due to being economical, effective, their ease availability and due to their safety. Because of these advantages the use of medicinal plants has been widely increased by the traditional medical practitioners in their day to day practice. 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. 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.

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. 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. The continuous increase in incidences of cardiovascular disease is a manifestation of chronic poor diet and lifestyle choices, which lead to diabetes and obesity. 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.

Various phytoconstituents from plants were responsible for cardioprotective activity. Refer Table 1.

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 (malonaldehyde) 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.
Table 1: Various phytoconstituents from plants were responsible for cardioprotective activity

<table>
<thead>
<tr>
<th>Phytoconstituents</th>
<th>Plant name</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allicin, sulphur compounds</td>
<td>Allium sativum</td>
<td>Liliaceae</td>
</tr>
<tr>
<td>Flavonoids, carotenoids</td>
<td>Anacardium occidentale</td>
<td>Anacardiaceae</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td>Antiaristolochia</td>
<td>Moraceae</td>
</tr>
<tr>
<td>Saponins- Shatavariins I–IV</td>
<td>Asparagus racemosus</td>
<td>Asparagaceae</td>
</tr>
<tr>
<td>Triterpenes</td>
<td>G. lucidum</td>
<td>Ganodermaeae</td>
</tr>
<tr>
<td>Triterpenoids</td>
<td>L. pyrotechnica</td>
<td>Asclepiadaceae</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td>D. purpurea</td>
<td>Scrophulariaceae</td>
</tr>
<tr>
<td>Alkaloidal constituents,</td>
<td>T. cordifolia</td>
<td>Menispermaceae</td>
</tr>
<tr>
<td>including berberine;</td>
<td></td>
<td></td>
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<tr>
<td>bitter principles,</td>
<td></td>
<td></td>
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<tr>
<td>including columbin,</td>
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<tr>
<td>chasmanthin, palmarin and</td>
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<tr>
<td>tinosporon, tinosporic</td>
<td></td>
<td></td>
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<tr>
<td>acid and tinosporol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caffeic acid</td>
<td>R. sativus</td>
<td>Cruciferae</td>
</tr>
<tr>
<td>Protein</td>
<td>E. ferox</td>
<td>Nymphaeae</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Plant/Family name</th>
<th>Dose administered mg/kg</th>
<th>Extract</th>
<th>In vitro/in vivo model</th>
<th>Mechanism involved and observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacopamonnieri, Scrophulariaceae</td>
<td>50, 100, 150, 200</td>
<td>hydroalcoholic</td>
<td>Isoproterenol induced myocardial necrosis in rats</td>
<td>Antioxidant components (Bacosides A and B) caused significant rise in endogenous antioxidants (SOD, CAT, GSH) and decrease in MDA</td>
</tr>
<tr>
<td>Cocos nucifera, Palmae</td>
<td>100</td>
<td>Water</td>
<td>Isoproterenol induced myocardial infarction in albino rats</td>
<td>Decrease in serum enzymes (CPK, LDH, SGOT, SGPT) and very little myocardial damage in isoproterenol treated rats fed tender coconut water</td>
</tr>
<tr>
<td>Cichorium intybus, Compositae</td>
<td>500</td>
<td>Aqueous</td>
<td>Ageing myocardium of albino rats</td>
<td>Cichorium extract was found to ameliorate the age induced injury and offered protection to the heart from oxidative damage and also found to decrease serum enzymes</td>
</tr>
<tr>
<td>Colebrookea oppositifolia, Lamiaceae</td>
<td>250, 500</td>
<td>Methanolic</td>
<td>Doxorubicin (DOX) induced cardiotoxicity in albino rats</td>
<td>The study of lipid peroxidation and anti-oxidant enzymes revealed that the malondialdehyde level was decreased. GS, SOD and CAT levels were significantly rised in C. oppositifolia extract treated group</td>
</tr>
<tr>
<td>Curcuma longa, Zingiberaceae</td>
<td>100</td>
<td>hydroalcoholic</td>
<td>Isoproterenol induced hemodynamic, biochemical and histopathological alternations in rats</td>
<td>Administration of hydroalcoholic extract 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</td>
</tr>
<tr>
<td>Cynodon dactylon, Poaceae</td>
<td>25, 50, 100, 200 μg/wl</td>
<td>hydroalcoholic</td>
<td>Ischemia/reperfusion (I/R) induced arrhythmias</td>
<td>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</td>
</tr>
<tr>
<td>Plant Name</td>
<td>Concentration</td>
<td>Extract Type</td>
<td>Activity Description</td>
<td>Summary</td>
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<td>--------------------------------</td>
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</tr>
<tr>
<td><em>Daucus carota</em>, Umbeliferae</td>
<td>250-500 μg/μl</td>
<td>Aqueous</td>
<td>Isoproterenol induced myocardial infarction in albino rats</td>
<td>Aqueous extract showed a decrease in serum aspartate transaminase (AST), alanine transaminase (ALT), lipid peroxidase, lactate dehydrogenase levels and cardiac total protein lipid peroxidase, and lactate dehydrogenase.</td>
</tr>
<tr>
<td><em>Dracocephalum moldavica</em>, Labiatae</td>
<td>25-200 μg/μl</td>
<td>Total extract (Methanol-water)</td>
<td>Ischemia/Reperfusion induced arrhythmias and infarcts in the isolated rat heart</td>
<td>Total extract of <em>D. moldavica</em> caused a significant reduction in the number of ventricular tachycardia (VT), total ventricular arrhythmias (VEBs) and VT duration in ischemic and reperfusion periods.</td>
</tr>
<tr>
<td><em>Embelica ribes</em>, Myrsinaceae</td>
<td>100</td>
<td>Aqueous</td>
<td>Isoproterenol induced myocardial infarction in albino rats</td>
<td>Pretreatment with an aqueous extract of <em>E. ribes</em>, significantly reduced the elevated marker enzyme levels in serum and heart homogenates and also enhanced the antioxidant defense system against isoproterenol-induced myocardial infarction.</td>
</tr>
<tr>
<td><em>Ficus hispida</em>, Moraceae</td>
<td>400 mg/kg</td>
<td>Methanolic</td>
<td>Cyclophosphamide induced oxidative myocardial injury in a rat model</td>
<td>Methanolic extract of <em>F. hispida</em> protected the cardiac tissue by scavenging the free radicals, which was proved by normalization of biochemical parameters.</td>
</tr>
<tr>
<td><em>Tribulus terrestris</em>, Zygophyllaceae</td>
<td>250</td>
<td>Hydroalcoholic</td>
<td>Isoproterenol induced myocardial infarction in rats</td>
<td><em>T. terrestris</em> hydroalcoholic extract decreased the leakage of CK-MB and LDH enzymes from the myocardium. Presence of antioxidant constituents (flavonoids) in the extract might be responsible for its cardioprotection.</td>
</tr>
<tr>
<td><em>Trichopouseleniumus</em>, Trichopodaceae</td>
<td>500</td>
<td>Ethanollic</td>
<td>Isoproterenol induced myocardial infarction in rats</td>
<td>Significant decline was shown in the activities of cardiac markers such as ALT, AST, LDH and CK in the heart of acute isoproterenol-treated rats.</td>
</tr>
<tr>
<td><em>Withania somnifera</em>, Solanaceae</td>
<td>300</td>
<td>Ethanollic</td>
<td>Doxorubicin-induced cardiotoxicity in rats</td>
<td>Significant decrease in serum enzymes</td>
</tr>
<tr>
<td><em>Zingiber officinalis</em>, Zingiberaceae</td>
<td>200</td>
<td>Ethanollic</td>
<td>Isoproterenol induced oxidative myocardial necrosis in rats</td>
<td>Significant decline was shown in the activities of cardiac markers such as ALT, AST, LDH and CK.</td>
</tr>
<tr>
<td><em>Cinnamomum tamala</em>, Lauraceae</td>
<td>200 and 400</td>
<td>Ethanollic extract</td>
<td>Doxorubicin-induced cardiotoxicity in rats</td>
<td>Significant cardio protective activity by lowering the levels of serum marker enzymes and lipid peroxidation and elevated the levels of catalase.</td>
</tr>
<tr>
<td><em>Garcinia indica</em>, 250 and 500</td>
<td>aqueous extract</td>
<td>Isoproterenol induced oxidative myocardial necrosis in rats</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><em>Pithecellobium dulce</em></td>
<td>200</td>
<td>aqueous and ethanolic extract</td>
<td>Isoproterenol induced oxidative myocardial necrosis in rats</td>
<td>Aqueous and ethanolic extracts of <em>P. dulce</em> fruit peel reverses the cardiac damage induced by isoproterenol.</td>
</tr>
</tbody>
</table>
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.

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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 an appropriate pharmacological screening approach.