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NATURAL CARDIOVASCULAR PROTECTANTS: A PHARMACOLOGICAL PERSPECTIVE

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ABSTRACT

Cardio vascular disease is a very dangerous disease it is related to heart. According to WHO guide for 17.9 million people die annually from Cardio vascular disease, a guesstimated 32% of the death in world, 85% were due to heart failure and embolic stroke. Phytochemicals are useful in lowering cardiovascular risks, especially for lowering blood cholesterol, lowering obesity-related factors, controlling blood sugar and the consequences of type 2 diabetes, controlling oxidative stress factors and inflammation, and pre venting platelet aggregation. Cardiovascular diseases (CVDs) remain the leading cause of global mortality, necessitating the exploration of safer and more effective therapeutic strategies. The analyzed review articles collectively emphasize the growing importance of herbal and natural-product-based interventions in the prevention and management of cardiovascular disorders. These studies highlight that phytochemicals such as flavonoids, polyphenols, terpenoids, saponins, and plant sterols exhibit multifaceted cardioprotective effects, including antioxidant, anti-inflammatory, antihypertensive, anti-atherosclerotic, antiplatelet, and lipid-lowering activities. Medicinal plants such as Panax ginseng, Ginkgo biloba, Ganoderma lucidum, Salvia miltiorrhiza and have demonstrated significant modulation of key molecular pathways, including nitric oxide synthesis, ACE inhibition, NF-κB signalling, calcium channel regulation, and oxidative stress reduction. The reviews further discuss the role of herbal drugs as complementary or alternative therapies alongside conventional cardiovascular medicines, highlighting improved patient tolerance and reduced adverse effects.

Keywords: *Natural products, antioxidant, anti-inflammatory, cardiotoxicity and clinical trials.*

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**I.INTRODUCTION**

Myocardial infarction (MI) or heart attack and associated complications are the primary causes of mortality in the entire world [1]. The application of herbal antioxidants is on the rise as protective factors against cardiovascular abnormalities. The natural bioactive sources have acquired basic significance in the contemporary system of medicine, eliminating the threats of heart diseases through scavenging the formation of free radicals [2]. CVDs pose a significant problem to millions of people each year, and they are the cause of death of the largest number of people worldwide, with an estimate of 31% [3]. CVDs are known as diseases of the heart or blood vessels. An annual worldwide mortality rate as a consequence of CVDs is more than 17 million. Therefore, CVDs remain the most prevalent causes of

death in the world, and an enormous economic and health burden to the globe. The World Health Organisation (WHO) indicates that every year, 31 percent of the deaths in the world are due to CVDs [4]. Such herbal remedies contain bioactive compounds, such as avones, triterpenic acids, and phenolic carboxylic acids, which have been shown to have positive effects on the treatment of CVDs [5]. Modern evaluation methods have recently led to the realization of the pharmacological effects and the underlying systemic, or molecular, effects of herbal medicines [6]. the body is an antioxidant. Intake of polyphenols has an inverse relationship with heart disease [7]. The global burden of cardiovascular disease is huge and growing. In 1990, the death toll of people with cardiovascular disease was about 14 million, and this is expected to increase to

some 25 million by 2020 [8]. The rising cases of cardiovascular disease are a symptom of the poor diet and living pattern, which has become chronic and thus causes diabetes and obesity [9]. Western medicinal drugs are highly acceptable in the treatment of hypertension, congestive heart failure, and post-myocardial infarction [10].

1.1 Cerebral And Peripheral Vascular Disease

The maidenhair tree or ginkgo biloba, over 200 million years old, was saved by human beings, it grows in the Far East temples and vanished in the West until it was re-introduced to Europe in 1730. Although the tree has been used in traditional Chinese medicine since ancient times, it was not widely known as a medicinal product until the 20th century when a concentrated extract of the leaves, called Ginkgo biloba extract (GBE), was developed, using Flavonoids that act both by decreasing capillary permeability and fragility and as antioxidants [11]. Studies such as a randomized, placebo, and double-blind trial have demonstrated that EGb 761 standardized extract can reduce ischemic regions and can have a beneficial effect on the intermittent claudication and peripheral artery disease [12]. GBE is mainly used to treat cerebral insufficiency and its related symptoms, such as vertigo, tinnitus, memory issues, and mood disturbances [13].

1.2 Atherosclerosis

The *Allium sativum* and Garlic have long been recognized as a cooking and a healing ingredient. The recent scientific research focus has been on the prevention of atherosclerosis with garlic and the beneficial impact of the substance on the heart system [14]. Research has shown that garlic is able to reduce blood pressure, prevent platelet aggregation, increase brinolytic activity, decrease the level of serum cholesterol and triglyceride and maintain the elastic nature of the aorta. Intake of high amounts of fresh garlic (0.25 to 1.0 g/kg) has been found to result in the following benefits. In high cholesterol men, a double-blind crossover trial revealed that 7.2 g of aged garlic extract resulted in significant reduction of the level of total serum cholesterol and LDL cholesterol relative to a placebo [15,16]. Although the results are positive, not all the researchers are comfortable with the routine use of garlic in the treatment of cardiovascular disease because most studies have methodological weaknesses, including small sample sizes, statistical power, and poor randomization. A study has found that the effect of garlic on lipid levels was not confirmed and another study has reported that the effect of garlic on cholesterol absorption and metabolism was not confirmed hence the need to carry out larger and more extensively designed studies to clearly determine the cardiovascular benefits of this compound [17].

1.3 Angina Pectoris

It is also known that in modern herbal literature to have cardiovascular tonic benefits, particularly in angina, belonging to oligomeric procyanins, flavonoid, and catechin-based active compounds, which act as antioxidants and prevent the production of thromboxane [18]. Clinical trials indicate *Crataegus* to have cardiac performance enhancement effects in heart failure patients possibly as a result of blocking phosphodiesterase 3,5, cyclic adenosine monophosphate, resulting in increased cardiac perfusion, mild hypotension, and positive inotropic, and negative chronotropic effects [19]. Which is also referred to as pseudoginseng by its similarity to *Panax ginseng*, is utilized in traditional Chinese medicine as analgesia, hemostasis, angina, and coronary artery disease. Even though it is promising, it requires clinical trials in order to confirm its cardiovascular benefits. *Salvia miltiorrhiza* (dan-shen), a cousin of sage, is a circulatory and sedative (*Salvia miltiorrhizae*: Systematic Nomenclature, 2017). It causes coronary artery dilation, platelet aggregation inhibition and myocardial mitochondrial membrane ischemia-reperfusion injury prevention as a result of free radical-scavenging. Clinical trials should be undertaken to test its safety and efficacy in relation to its interaction with warfarin that may expose more adverse effects of warfarin.

1.4 Arrhythmia

Arrhythmias in the traditional Chinese medicine are linked by analogous symptoms as uttering sensations and irregular eye blink. A number of Chinese herbal drugs are reported to have antiarrhythmic goods analogous as *Xin bao*, *ci Zhu wan* and *bu Xin dan* among others.

1.5 Hypertension

The two main factors that increase the trouble of CVDs, hypertension and atherosclerosis, can be favourably modulated and eventually bettered by herbal remedies and their derivatives. Herbal treatments have multiple cellular of action since they contain a variety of bioactive. Herbal treatments can actually have- seditious, vasorelaxant, antioxidant, and anti- proliferative parcels. Inhibiting endothelial dysfunction activation of platelets, lipid peroxidation, and product of ROS & microglia atherogenicity are fresh benefits of using herbal treatments to stop VSMC phenotypic flipping.

2.1 INDIAN HERBAL MEDICINES OF CARDIOPROTECTIVE AGENTS

Indian herbal medicine, mainly based on the traditional system of Ayurveda, has been used for thousands of years to prevent and treat heart-related diseases. Cardiovascular diseases (CVDs) such as hypertension, atherosclerosis, myocardial infarction, and heart failure are major causes of death worldwide. In recent years, there has been increasing scientific interest in Indian herbal medicines due to their effectiveness and minimal adverse effects. These herbal agents are widely used both

in traditional and modern medicine for the prevention and management of cardiovascular diseases. Therefore, Indian herbal cardioprotective agents play a vital role in promoting heart health and improving quality of life.

2.1 TULSI (OCIMUM SANCTUM)

- Constituents: Eugenol, Ursolic acid
- Actions: Antioxidant, antihypertensive
- Uses: Stress-induced cardiac disorders

2.2 NEEM (AZADIRACHTA INDICA)

- Constituents: Nimbin, quercetin
- Actions: Antioxidant, anti-inflammatory
- Uses: Cardiovascular complications associated with diabetes

2.3 TURMERIC (CURCUMIN)

- Part used: Rhizome
- Constituents: Curcuminoids, Curcuminoids
- Uses: Cardiomyocyte protection, Atherosclerosis, Hypertension (adjunct therapy)

2.4 ASHWAGANDHA (Withania somnifera)

- Part used: Branches
- constituents: Withanolides
- Uses: Hypertension, myocardial infarction

2.5 Cardamom (Elettaria cardamomum)

- Part used: Dried ripe fruits (seeds)
- Constituents: Volatile oils, Flavonoids, Phenolic compounds
- Uses: Hypertension, Hyperlipidemia, Atherosclerosis, Coronary artery disease

2.6 GINGER (Zingiber officinale Roscoe)

- Part used: Rhizome
- Constituents: Phenolic compounds, Volatile oils
- Uses: Atherosclerosis, Hypertension, Coronary artery disease

2.7 Betel Leaf (Piper beetle Linn.)

- Part used: Leaves
- Constituents: Phenolic compounds, Flavonoids, Vitamins (A, C)
- Uses: Atherosclerosis, Hyperlipidemia, Oxidative stress-induced cardiac damage

2.8 Amla (syn. Emblica officinalis)

- Part used: Fruits
- Constituents: Vitamin C (Ascorbic acid), Tannins, Flavanoids
- Uses: Hyperlipidemia, Atherosclerosis, Coronary artery disease, Hypertension

2.9 Ajwain Leaf (Trachyspermum Ammi (L.) Sprague)

- Part used: Leaves
- Constituents: Phenolic compounds, Flavonoids, Terpenes and tannin
- Uses: Hypertension, Atherosclerosis, Oxidative stress-induced cardiac damage

2.10 Tea Leaf (Camellia sinensis (L.) Kuntze)

- Part used: Leaves (young leaves and buds)

- Constituents: Polyphenols, Flavonoids, Tannins, Amino acids, Vitamins (C, B-complex)
- Uses: Coronary heart disease, Hypertension, Hyperlipidemia, Atherosclerosis

2.11. Garlic (Allium sativum Linn.)

- Part used: Bulb
- Constituents: Organosulfur compounds, Sulfoxides, Flavonoids and saponins
- Use: Hypertension, Atherosclerosis, Coronary artery disease

3. MECHANISM OF CARDIO-PROTECTIVE ACTION

- Herbal cardioprotective agents protect the heart through multiple mechanisms:
- **ANTIOXIDANT ACTIVITY:** Neutralize free radicals and prevent oxidative damage to heart tissues.
- **ANTI-INFLAMMATORY EFFECT:** Reduce inflammation in blood vessels and cardiac muscles.
- **HYPOLIPIDEMIC EFFECT:** Lower cholesterol and triglyceride levels.
- **VASODILATION:** Improve blood flow by relaxing blood vessels.
- **ANTI-PLATELET ACTION:** Prevent clot formation and reduce risk of heart attack.
- **MYOCARDIAL PROTECTION:** Strengthen heart muscles and prevent cell damage

4. SAFETY, TOXICITY AND SIDE EFFECT

Herbal medicines have been traditionally used for the prevention and management of cardiovascular diseases such as hypertension, ischemic heart disease, dyslipidaemia and heart failure. Many herbs exhibit cardioprotective activity through antioxidant, anti-inflammatory, antihypertensive, antiplatelet and lipid-lowering mechanisms, they are not completely free from adverse effects or toxicity.

4.1 Safety Profile of Herbal Cardio-protective Agents

Most herbal cardioprotective agents have a wide margin of safety when used in recommended doses and for short durations. Herbs like Arjuna, Amla, Garlic, Turmeric, Ginger and Tulasi are generally safe for long-term use under supervision.

Factors influencing safety include:

- Quality and purity of herbal preparation
- Dose, duration and method of administration
- Patient-related factors (age, pregnancy, comorbidities)

Standardization and quality control play an important role in reducing adverse reactions and ensuring safety.

4.2 Side Effects of Herbal Cardio-protective Agents

A. Gastrointestinal Effects

Most common and mild

- Nausea and vomiting

- Gastric irritation and acidity
- Diarrhea or constipation

Examples: Garlic, ginger, turmeric, ajwain, arjuna

B. Cardiovascular Effects

- Hypotension due to excessive vasodilation
- Bradycardia or palpitations in sensitive individuals

- Examples: Garlic, black seed, neem, Andrographis

C. Central Nervous System Effects:

- Headache
- Drowsiness or fatigue

Examples: Ashwagandha, neem

4.3 Toxicity of Herbal Cardio-protective Agents

Although uncommon, toxicity may occur due to overdose, prolonged use or use of concentrated extracts.

A. Cardiotoxicity:

Digitalis purpurea contains cardiac glycosides with a narrow therapeutic index

- Toxicity manifests as:
- Arrhythmias Strict dose monitoring is essential.

B. Electrolyte Imbalance:

- Licorice (Mulethi) causes sodium retention and potassium loss
- Leads to hypertension, edema and arrhythmias

C. Hepatotoxicity:

- Neem oil ingestion
- Excess cassia cinnamon (coumarin content)

Manifests as elevated liver enzymes and jaundice

D. Hemorrhagic Risk:

- Garlic, ginger, turmeric and amla inhibit platelet aggregation
- Increased risk of bleeding, especially with anticoagulants

4.4 Drug–Herb Interactions

Herbal cardioprotective agents may interact with conventional drugs:

- Potentiation of antihypertensive drugs → severe hypotension
- Digitalis toxicity enhanced by diuretics and electrolyte imbalance

4.5 Contraindications and Precautions

- Pregnancy and lactation (neem, Andrographis, ashwagandha)
- Patients on anticoagulant or antiplatelet therapy
- Elderly patients and those with multiple comorbidities
- Long-term use should be avoided without medical supervision

4.6 Advantages and Limitations

Advantages

- Natural origin
- Multiple mechanisms of cardio protection

- Lower incidence of severe adverse effects
- Limitations
- Limited clinical trial data
- Potential for misuse and self-medication

5. FUTURE DIRECTIONS IN HERBAL MEDICINE FOR CARDIOVASCULAR HEALTH

Emerging Research Trends: Current research is beginning to identify new herbal compounds and bioactive molecules with cardioprotective actions. Components like berberine (found in Berberis), curcumin (Curcuma longa), and resveratrol (grapes) are emerging for their cardioprotective potential in modulating blood pressure, inflammation, and lipid profiles. Advances in phytochemistry and molecular biology are also allowing isolation of individual active constituents accountable for cardiovascular effects, the future of which promises more promising herbal therapies.

The Role of Personalized Medicine: Individualized medicine is redefining treatment strategy, and herbal medicine is not exempt. Taking into account genetic predisposition, lifestyle patterns, and environmental exposure, potential herbal therapies of the future can be tailored to enhance efficacy with fewer side effects. For example, patients harboring certain lipid metabolism-altering genetic markers could potentially respond favorably to some plant-derived molecules more than others. This interdisciplinary, individualized approach has potential to optimize cardiovascular outcomes and elevate herbal medicine into the category of precision medicine.

6.CONCLUSION

The antioxidant, anti-inflammatory, antihypertensive, hypolipidemic, and antiplatelet rates of herbal specifics make them important cardioprotective agents. The forestalment and treatment of cardiovascular conditions have been demonstrated to benefit from the use of shops including arjuna, garlic, amla, turmeric, Tulasi, and gusto. When used in the right tablets, herbal cardioprotective drugs are generally safer, better permitted, and suited for long- term operation than synthetic specifics. Herbal specifics can still have negative side goods and be toxic, however. In some situations, gastrointestinal problems, hypotension, electrolyte imbalance, bleeding threat, and cardiotoxicity might affect from overdosing, extended use, shy quality control, and medicine- condiment combinations. Liquorice and Digitalis purpurea are two exemplifications of sauces with a limited remedial indicator that need close observation and medical operation. To guarantee their effectiveness and safety, pharmacovigilance, clinical exploration, and scientific confirmation are pivotal. Herbal remedies can be useful adjuncts in the treatment of cardiovascular complaint when taken sparingly.

7.AUTHOR CONTRIBUTIONS

All authors are contributed equally.

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None

9.DECLARATION COMPETING INTEREST

The authors have no conflicts of interest to declare.

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