



A Review on Cardioprotective Plants Using for Treatment of Hearts Disease

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Received: 26 Feb 2026 / Accepted: 20 Mar 2026/ Published online: 01 April 2026

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Abstract

Cardio protective plants play a significant role in maintaining heart health and preventing cardiovascular diseases. These plants are rich in bioactive compounds which are using for treat heart disease these constituents are such as flavonoids, alkaloids, tannins, and antioxidants that help reduce oxidative stress, regulate blood pressure, and improve lipid profiles. Arjuna Tree (*Terminalia arjuna*): Known to strengthen cardiac muscles and manage ischemia. Garlic (*Allium sativum*): Contains allicin, which lowers cholesterol and blood pressure. Hawthorn (*Crataegus oxyacantha*): Often used for improving blood flow and treating arrhythmias. Turmeric (*Curcuma longa*): Its component curcumin reduces cardiac oxidative stress. Tulsi (*Ocimum sanctum*): Acts as an anti-inflammatory and supports healthy cardiac function. Gokhru (*Tribulus terrestris*): Offers protection against myocardial ischemic injuries. Moringa (*Moringa oleifera*): Known for its antioxidant properties (specifically the leaves). Neem (*Azadirachta indica*): Helps in reducing cardiovascular risk factors. One well-known cardioprotective plant is garlic (*Allium sativum*), which helps lower cholesterol levels, reduce blood pressure, and prevent platelet aggregation, thereby decreasing the risk of atherosclerosis. Similarly, green tea (*Camellia sinensis*) contains catechins that exhibit strong antioxidant properties, protecting the heart by improving endothelial function and reducing inflammation. Another important plant is turmeric (*Curcuma longa*), whose active compound curcumin has anti-inflammatory and antioxidant effects that support cardiovascular health. Hawthorn (*Crataegus* species) has been traditionally used to strengthen heart muscles, improve blood circulation, and manage heart failure symptoms. Additionally, flaxseed (*Linum usitatissimum*) is rich in omega-3 fatty acids and lignans, which help reduce cholesterol levels and maintain arterial health. These plants not only prevent the onset of heart diseases but also support overall cardiovascular function. Incorporating such plants into daily diets, along with a healthy lifestyle, can significantly reduce the risk of heart-related disorders and promote long-term heart health.

Keywords

Antioxidant, Cardiovascular, Cholesterol, Heart-related disorders, Turmeric.

1. INTRODUCTION:

Cardio protective Plants:

Cardioprotective plants are natural, phytochemical-rich botanicals that help prevent and manage cardiovascular diseases by reducing oxidative stress, inflammation, and blood pressure, as well as improving lipid profiles. examples include Arjuna tree (*Terminalia arjuna*), Garlic, Hawthorn,

Turmeric, and Tulsi, which provide protective effects against ischemia, arrhythmias, and heart damage.

Commonly Used Parts Bark:

Terminalia arjuna Leaves: *Ocimum sanctum*, *Azadirachta indica*

Root/Stem: *Tinospora cordifolia*

Fruit/Bulb: *Allium sativum* (bulb), *Crataegus* (berry). Mechanisms of Action These plants protect the heart through several key pathways Antioxidant Effects: Many plants, such as blueberries and Moringa, reduce oxidative stress that causes vascular damage. Anti-inflammatory: Active compounds reduce pro-inflammatory cytokines, reducing atherosclerosis. Blood Pressure Reduction: Plants like Gokhru and Garlic help regulate blood pressure. Lipid Management: Various herbs help regulate blood lipids (antilipidemic), reducing plaque buildup [1].

Cardioprotective Plants and Their Potential Benefits

Arjuna Tree (*Terminalia arjuna*): Known to strengthen cardiac muscles and manage ischemia.

Garlic (*Allium sativum*): Contains allicin, which lowers cholesterol and blood pressure.

Hawthorn (*Crataegus oxyacantha*): Often used for improving blood flow and treating arrhythmias [2].

Turmeric (*Curcuma longa*): Its component curcumin reduces cardiac oxidative stress.

Tulsi (*Ocimum sanctum*): Acts as an anti-inflammatory and supports healthy cardiac function.

Gokhru (*Tribulus terrestris*): Offers protection against myocardial ischemic injuries.

Moringa (*Moringa oleifera*): Known for its antioxidant properties (specifically the leaves).

Neem (*Azadirachta indica*): Helps in reducing cardiovascular risk factors [3].

2. Human Heart: The heart is a fist-sized, four-chambered muscular organ located in the chest that pumps blood throughout the body via the circulatory system. Your heart is in the front of your chest. It sits slightly behind and to the left of your sternum (breastbone), which is in the middle of your chest. heart is slightly on the left side of your body. It sits between your right and left lungs. The left lung is slightly smaller to make room for the heart in your left chest. Your rib cage protects your heart. It delivers oxygen and nutrients to tissues while removing carbon dioxide and waste, beating roughly 100,000 times daily. Key functions include maintaining blood pressure and supporting overall cardiovascular health. Your muscular heart, the main organ in your cardiovascular system, is vital for life. Its parts work together to move blood through your body in a coordinated way [4]. It constantly sends oxygen to your cells and takes away waste. Many conditions can affect this organ and keep it from working well. The heart is a fist-sized organ that pumps blood throughout your body. It's your circulatory system's main organ. Muscle and tissue make up this powerhouse organ [5]. Your heart contains four muscular sections (chambers) that briefly hold blood before moving it. Electrical impulses make your heart beat, moving blood through these chambers. Your brain and nervous system direct your heart's function [6].

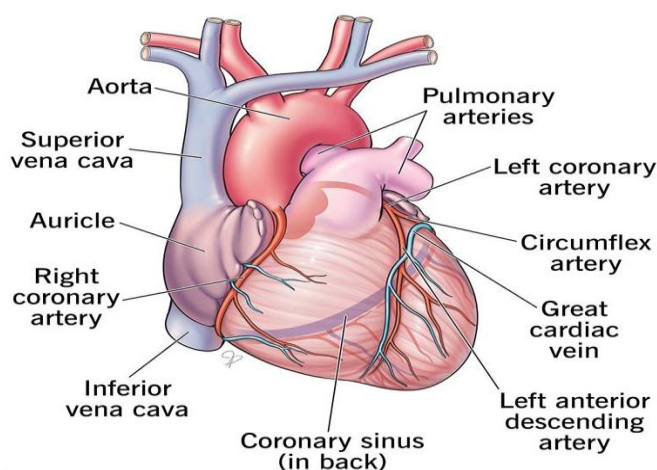


Figure 1: Human Heart

FUNCTION OF THE HEART:

Your heart's main function is to move blood throughout your body. Blood brings oxygen and nutrients to your cells. It also takes away carbon dioxide and other waste so other organs can dispose of them. Your heart also Controls the

rhythm and speed of your heart rate. Maintains your blood pressure. Your heart works with these body systems to control your heart rate and other body functions nervous system helps control your heart rate. It sends signals that tell your heart to beat slower during rest and faster

during stress. Endocrine system sends out hormones [7]. These hormones tell your blood vessels to constrict or relax, which affects your blood pressure. Hormones from your thyroid gland can also tell your heart to beat faster or slower [8].

Human Heart walls

Your heart walls are the muscles that contract (squeeze) and relax to send blood throughout your body. A layer of muscular tissue called the septum divides your heart walls into the left and right sides [9].

Your heart walls have three layers:

Endocardium: Inner layer.

Myocardium: Muscular middle layer.

Epicardium: Protective outer layer.

The epicardium is one layer of your pericardium.

The pericardium is a protective sac that covers your entire heart. It produces fluid to lubricate your heart and keep it from rubbing against other organs [10].

Heart chambers

Your heart has four separate chambers. You have two chambers on the top (atrium, plural atria) and two on the bottom (ventricles), one on each side of your heart [11].

Right atrium: Two large veins deliver oxygen-poor blood to your right atrium. The superior vena cava carries blood from your upper body. The inferior vena cava brings blood from your lower body. Then the right atrium pumps the blood to your right ventricle.

Right ventricle: The lower right chamber pumps the oxygen-poor blood to your lungs through the pulmonary artery. The lungs reload the blood with oxygen.

Left atrium: After the lungs fill your blood with oxygen, the pulmonary veins carry the blood to the left atrium. This upper chamber pumps the blood to your left ventricle.

Left ventricle: The left ventricle is slightly larger than the right. It pumps oxygen-rich blood to the rest of your body [12].

Heart valves

Your heart valves are like doors between your heart chambers. They open and close to allow blood to flow through. They also keep your blood from moving in the wrong direction.

Atrioventricular valves

The atrioventricular (AV) valves open between your upper and lower heart chambers. They include

- Tricuspid valve: Door between your right atrium and right ventricle.

- Mitral valve: Door between your left atrium and left ventricle [13,14].

Semilunar valves

Semilunar (SL) valves open when blood flows out of your ventricles. They include:

Aortic valve: Opens when blood flows out of your left ventricle to your aorta (artery that carries oxygen-rich blood to your body).

Pulmonary valve: Opens when blood flows from your right ventricle to your pulmonary arteries (the only arteries that carry oxygen-poor blood to your lungs) [15].

Blood vessels

Your heart pumps blood through three types of blood vessels

- Arteries carry oxygen-rich blood from your heart to your body's tissues. The exception is your pulmonary arteries, which go to your lungs.
- Veins carry oxygen-poor blood back to your heart.
- Capillaries are small blood vessels where your body exchanges oxygen-rich and oxygen-poor blood [16].

Coronary arteries

Your heart receives nutrients through a network of coronary arteries. These arteries run along your heart's surface. They serve the heart itself and include the:

Left coronary artery: Divides into two branches (the circumflex artery and the left anterior descending artery).

Circumflex artery: Supplies blood to the left atrium and the side and back of the left ventricle.

Left anterior descending artery (LAD): Supplies blood to the front and bottom of the left ventricle and the front of the septum.

Right coronary artery (RCA): Supplies blood to the right atrium, right ventricle, bottom portion of the left ventricle and back of the septum [17].

Electrical conduction: Electrical conduction system Your heart's conduction system is like the electrical wiring of a building. It controls the rhythm and pace of your heartbeat. Signals start at the top of your heart and move down to the bottom. Your conduction system includes.

Sinoatrial (SA) node: Sends the signals that make your heart beat.

Atrioventricular (AV) node: Carries electrical signals from your heart's upper chambers to its lower ones.

Left bundle branch: Sends electric impulses to your left ventricle.

Right bundle branch: Sends electric impulses to your right ventricle.

Bundle of His: Sends impulses from your AV node to the Purkinje fibers.

Purkinje Fibre: Make your heart ventricles contract and pump out blood [18].

List of Heart Diseases: Heart conditions are among the most common types of disorders. In the United States, heart disease is the leading cause of death [19].

Common conditions that affect your heart include:

Arrhythmia: A heartbeat that's too fast, too slow or beats with an irregular rhythm.

Cardiomyopathy: Unusual thickening, enlargement or stiffening of your heart muscle.

Congestive heart failure: Your heart is too stiff or too weak to properly pump blood throughout your body.

Coronary artery disease: Plaque buildup that leads to narrow coronary arteries.

Diabetes: Your blood sugar is higher than it should be.

Heart attack (myocardial infarction): A sudden coronary artery blockage that cuts off oxygen to part of your heart muscle.

Heart valve disease: A valve in your heart isn't working right.

High blood pressure: Your blood is pushing too hard against your artery walls.

High cholesterol: Your blood has too many fats in it.

Pericarditis: Inflammation in your heart's lining (pericardium) [20].

3. List of Cardio protective Plants:

A. Arjuna Tree: *T. arjuna* grows to about 20–25 metres tall; usually has a buttressed trunk, and forms a wide canopy at the crown, from which branches drop downwards. It has oblong, conical leaves which are green on the top and brown below; smooth, grey bark; it has pale yellow flowers which appear between March and June; its glabrous, 2.5 to 5 cm fibrous woody fruit, divided into five wings, appears between September and November. The tree does not suffer from any major diseases or any deadly pest infestation, but it is susceptible to *Phyllactinia terminale* and rot due to *polystictus affinis*. *Terminalia arjuna* offers a multitude of benefits for cardiac health through various mechanisms at the molecular level. The plant's oleanane triterpenoids, such as arjunic acid, arjunoglycosides, arjunone and arjunolic acid, are primarily responsible for its cardioprotective effects. The bark stem of Arjuna contains diuretic, inotropic and chronotropic effects. Its potent antioxidant activity helps reduce oxidative stress in cardiac cells, thereby preventing damage associated with heart diseases. The herb exhibits anti-apoptotic effects, reducing programmed cell death in cardiac cells during stress conditions like hypoxia, which is

facilitated by the regulation of specific signaling pathways. Additionally, *T.arjuna* modulates inflammatory responses by lowering levels of inflammatory cytokines, further supporting cardiac health. It enhances cardiac function by positively influencing calcium handling and myocardial metabolism, which improves contractility. *Terminalia arjuna* extract by alleviating the phosphorylation of JNK and c-jun and also by regulating protein expression levels of Bcl2, Bax, caspase 3, heat shock protein-70 and inducible nitric oxide synthase exhibit antioxidant and anti-apoptotic defense against ischemic-reperfusion injury by enhancing the expression of protective proteins. It also improves lipid profiles by lowering cholesterol levels, thereby reducing the risk of atherosclerosis and other cardiovascular conditions [21].

B. Garlic: Garlic (*Allium sativum*) is a species of bulbous flowering plants in the genus *Allium*. Its close relatives include the onion, shallot, leek, chives, Welsh onion, and Chinese onion. Garlic is native to central and western Asia, stretching from the Black Sea through the southern Caucasus, northeastern Iran, and the Hindu Kush. It has naturalized in many other parts of the world, including Mediterranean Europe and China. There are two subspecies and hundreds of varieties of garlic. Garlic has been used for thousands of years as a seasoning, culinary ingredient, and traditional medical remedy. It was known in many ancient civilizations, including the Babylonians, Egyptians, Jews, Romans, and Chinese and remains significant in many cuisines and folk treatments, especially across the Mediterranean and Asia. Sulfur compounds give garlic its pungent odor and flavor. There is insufficient clinical evidence to indicate that consuming garlic has any health benefits [22].

C. Hawthorn: Hawthorn (*Crataegus* spp.): provides significant cardioprotective benefits through antioxidant, anti-inflammatory, and vasodilating effects, primarily driven by flavonoids and oligomeric procyanidins. It improves cardiac output and coronary blood flow, often used to manage chronic heart failure (NYHA I–III), arrhythmias, and hypertension. cardioprotective mechanisms and activities include Heart Failure Support-Enhances cardiac contractility (positive inotropy) and improves myocardial function. Antioxidant & Anti-Inflammatory-Reduces oxidative damage to blood vessels and inhibits inflammation, protecting against

ischemia-reperfusion injury. Blood Pressure & Lipid Control-Helps lower high blood pressure and reduces serum lipid levels, including cholesterol. Anti-arrhythmic Potential-Stabilizes heart cell membranes and helps manage abnormal rhythms. Endothelial Function-Maintains healthy endothelial cell function and enhances nitric oxide (NO) levels. Hawthorn (*Crataegus*) provides cardioprotection primarily through antioxidant, anti-inflammatory, and vasodilating mechanisms, driven by high levels of flavonoids and oligomeric procyanidins (OPC). It enhances heart function by increasing contraction force (positive inotropy), reducing blood pressure, lowering cholesterol, and protecting endothelial cells from damage. Antioxidant & Anti-inflammatory Activity-Hawthorn extracts decrease oxidative stress and inhibit inflammation, reducing damage to blood vessels and tissues. Positive Inotropy & Heart Function-Hawthorn boosts the heart's pumping efficiency (contractility) by inhibiting phosphodiesterase, which makes it particularly useful for treating chronic heart failure (CHF). Vasodilation and Blood Pressure Lowering-The extract promotes nitric oxide (NO) production and lowers endothelin-1 (ET-1), which relaxes blood vessels and improves coronary artery blood flow. Hypolipidemic Effects Hawthorn reduces cholesterol levels by inhibiting its absorption in the intestines and suppressing hepatic synthesis, helping to prevent atherosclerosis. Anti-arrhythmic Potential It helps regulate heart rhythm. Myocardial Protection It protects the heart muscle from ischemia-reperfusion injury and prevents detrimental remodeling [23].

D. Turmeric: In *Curcuma longa* a primary active component, *curcumin*, provide significant cardioprotection through a multifaceted, pleiotropic mechanism of action. The key mechanisms involve *potent anti-inflammatory, anti-oxidative, anti-apoptotic, and anti-fibrotic actions*, primarily targeting signaling pathways that lead to cardiomyocytes' apoptosis, hypertrophy, and fibrosis. cardioprotective mechanisms of *Curcuma longa/curcumin* include Antioxidant Activity and ROS Scavenging: Curcumin directly scavenges reactive oxygen species (ROS) and activates the Nrf2/HO-1 (nuclear factor erythroid 2-related factor 2/heme oxygenase-1) pathway, reducing oxidative stress in myocardial ischemia-reperfusion (I/R) injury. It also inhibits ROS-generating enzymes like NADPH oxidase. Curcumin inhibits the activation of nuclear factor- κ B (NF- κ B), a key transcription factor regulating pro-inflammatory cytokines such as TNF- α , IL-1 β , and IL-6. It also reduces inflammation by modulating TLR4/MyD88/NF- κ B signaling pathways.

Curcumin preserves mitochondrial integrity, prevents mitochondrial dysfunction, and reduces cardiomyocyte apoptosis by upregulating anti-apoptotic markers (Bcl-2) and downregulating pro-apoptotic markers (Bax, caspases). Inhibition of Cardiac Hypertrophy and Fibrosis: It suppresses cardiac remodeling and fibrosis by inhibiting the TGF- β 1/Smad signaling pathway, reducing collagen deposition, and inhibiting p300-histone acetyltransferase activity, which is crucial for pathological cardiac remodeling. Angiogenesis and Vascular Repair Curcumin promotes angiogenesis by upregulating miR-93, enhancing the migration and proliferation of endothelial progenitor cells and aiding tissue repair in ischemic zones [24].

E. Tulsi: Scientific name is Holy Basil/ *Ocimum sanctum* acts as a cardioprotective agent through a multi-target, holistic approach that addresses the root causes of heart disease, including inflammation, oxidative stress, dyslipidemia, and stress. Its primary cardioprotective mechanisms are mediated by bioactive compounds such as eugenol, rosmarinic acid, and ursolic acid. Lipid-Lowering (Hypolipidemic) Action Tulsi reduces total cholesterol, triglycerides, and low-density lipoprotein (LDL/bad cholesterol) while improving HDL (good cholesterol) levels by inhibiting cholesterol biosynthesis and enhancing lipid metabolism. Tulsi increases endogenous antioxidant enzymes—such as superoxide dismutase (SOD), catalase, and glutathione—which neutralize reactive oxygen species (ROS) and reduce myocardial lipid peroxidation. Tulsi (*Ocimum sanctum* or *Ocimum tenuiflorum*) acts as a cardioprotective agent primarily through its potent antioxidant, anti-inflammatory, and lipid-lowering properties, which together mitigate stress-induced cardiac damage and improve cardiovascular function. Its main active compound, eugenol, acts as a 5-lipoxygenase (5-LOX) inhibitor and helps regulate blood pressure and cardiac health, while its ability to modulate metabolic stress prevents chronic heart diseases. Upregulating Enzymes It boosts endogenous antioxidant defenses, increasing levels of superoxide dismutase (SOD), catalase, and reduced glutathione (GSH), which protects heart cells from lipid peroxidation and damage. Tulsi Protection pre-treatment has been shown to protect against isoproterenol-induced cardiac necrosis, a standard model for studying myocardial infarction [25].

F. Gokhru: The Scientific name is *Tribulus terrestris*, and another name is Gokshura, it is a powerful Ayurvedic herb known for its diuretic, anti-inflammatory, and strengthening properties. Widely used for kidney stones, urinary tract infections (UTIs), sexual health, and managing uric acid/joint

pain, it helps balance Vata, Pitta, and Kapha. The fruits, leaves, and roots are utilizing *flavonoids* in medicines Gokhru (*Tribulus terrestris*), also known as Gokshura, exerts cardioprotective effects primarily through its rich content of bioactive compounds specifically *steroidal saponins* (like tribulosin, protodioscin), (quercetin, kaempferol), and *phytosterols* (beta-sitosterol). Its mechanism of action as a cardioprotective agent involves a multifaceted approach to reduce oxidative stress, improve lipid profiles, prevent cell death during ischemia, and regulate blood pressure. Anti-apoptotic Mechanism (Cardiac Protection during Ischemia) Gokhru pre-treatment provides significant anti-ischemic protection. It acts by reducing the expression of proteins that lead to apoptosis (programmed cell death) during ischemic insult via a MAPK-mediated pathway. ACE Inhibition and Hypotensive Effect Gokhru acts as a potential inhibitor of Angiotensin-Converting Enzyme (ACE). This inhibition relaxes blood vessels and reduces peripheral vascular resistance, leading to lower blood pressure and reduced workload on the heart. Hypolipidemic and Anti-atherosclerotic Activity Gokhru saponins reduce total cholesterol, triglycerides, and LDL ("bad") cholesterol, while partially repairing endothelial damage. This prevents the formation of plaques in coronary arteries (atherosclerosis). Nitric Oxide Regulation It enhances the release of nitric oxide (NO) from the endothelium and nerve endings, promoting vasodilation (widening of blood vessels) and improving blood circulation to the heart. Reduced Cardiac Dysfunction (Inhibition of ROS) Saponins in *T. terrestris* inhibit angiotensin II-induced vascular smooth muscle cell proliferation and suppress Reactive Oxygen Species (ROS) generation and LDH release in heart tissues [26].

G. Moringa: *Moringa oleifera* (MO) serves as a potent cardioprotective agent primarily through its rich phytochemical composition, which acts via antioxidant, anti-inflammatory, and anti-apoptotic mechanisms to protect cardiac structural integrity and function. The mechanism involves modulating multiple signaling pathways and reducing cardiovascular risk factors like hypertension, hyperlipidemia, and hyperglycemia. Moringa suppresses oxidative stress by scavenging free radicals and activating the Nrf2 pathway, which in turn boosts antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx). Moringa work as a Vasodilation and Endothelial Protection Moringa compounds improve endothelium-dependent relaxation by stimulating nitric oxide (NO) synthesis via the PI3K/Akt pathway, acting as a natural vasorelaxant

and protecting against aortic damage. Bioactive Compounds as a cardioprotective activity is attributed to a synergy of phytochemicals found in leaves and seeds, including in Flavonoids Quercetin-3-O-glucoside, rutin, kaempferol. Isothiocyanates/Glucosinolates N, α -L-rhamnopyranosyl vincosamide (VR), benzyl isothiocyanate. Phenolic Acids Chlorogenic acid, gallic acid [27].

F. Neem: *Azadirachta indica* acts as a cardioprotective agent primarily through its rich antioxidant content, anti-inflammatory mechanisms, and modulation of cardiovascular signaling pathways. Its main bioactive compounds, including nimbolide, azadirachtin, and nimbidin, work together to reduce myocardial injury by decreasing oxidative stress and inhibiting cell apoptosis (programmed cell death) in heart tissue. Antioxidant Defense Enhancement: Neem increases the activity of antioxidant enzymes like superoxide dismutase (SOD) and glutathione peroxidase (GPx), which scavenge free radicals and reduce lipid peroxidation in cardiac tissue. Ca^{++} channel Blockade (Calcium Antagonist): Neem extracts (especially the ethyl acetate fraction) act similarly to verapamil by blocking voltage-dependent calcium channels, which leads to vasorelaxation and lowered blood pressure. Anti-apoptotic Activity: Neem increases the expression of anti-apoptotic proteins such as Bcl-2 and downregulates pro-apoptotic proteins like Bax and Caspase-3, protecting myocardial cells from death following ischemic injury. Nitric Oxide (NO) Pathway Modulation: Neem leaf extract promotes vasodilation by increasing NO levels via up-regulation of endothelial nitric oxide synthase (eNOS), which helps reduce hypertension. Active Compounds which are responsible for these cardioprotective effects include Nimbolide Potent antioxidant, anti-inflammatory, and inhibitor of pro-apoptotic genes. Nimbidin A compound that contributes to anti-inflammatory activity. Neem Leaf Glycoprotein (NLGP) Known for immunomodulatory and anti-angiogenic properties. Quercetin & Polyphenols High antioxidant content [28].

4. Conclusion: Cardio protective plants play important role to promoting heart health and preventing cardiovascular diseases. Many medicinal plants contain bioactive compounds such as flavonoids, alkaloids, polyphenols, and antioxidants that help reduce oxidative stress, lower blood pressure, regulate lipid levels, and improve overall cardiac function. Plants like garlic, turmeric, green tea, and hawthorn have shown promising effects in protecting the heart by improving blood circulation, reducing inflammation, and preventing plaque

formation in arteries. These natural remedies often have fewer side effects compared to synthetic drugs and can be used as complementary approaches in cardiovascular care. Cardio protective plants represent a valuable and sustainable resource for maintaining heart health. However, their use should be supported by scientific research, proper dosage, and medical guidance to ensure safety and effectiveness. Integrating these plants into a balanced lifestyle, along with healthy diet and regular exercise, can significantly contribute to the prevention and management of heart diseases.

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