



A REVIEW ON PLANT BASED HYPERTENSION THERAPY SCIENTIFIC EVALUATION OF TERMINALIA ARJUNA AS A CARDIAC TONIC AND ANTIHYPERTENSIVE HERB

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ABSTRACT

Hypertension is a serious global health concern and a critical contributor to cardiovascular illness and death. The scientific assessment of Terminalia arjuna, a traditional medicinal herb well-known in Ayurveda for its cardioprotective qualities, has been prompted by the growing interest in plant-based therapeutic agents. The antihypertensive potential of T. arjuna is rigorously examined in this review, with particular attention paid to its phytochemical composition, mechanisms of action, and therapeutic efficacy. Significant bioactive components, including arjunolic acid, flavonoids, triterpenoids, and glycosides, have strong anti-inflammatory, vasodilatory, and antioxidant properties that help control blood pressure. Preclinical and clinical studies demonstrate that T. arjuna enhances cardiac function by increasing myocardial contractility, reducing oxidative stress, altering lipid profiles, and facilitating endothelial relaxation. Additionally, data shows its efficacy as an adjuvant therapy for mild to moderate to severe hypertension with low negative outcomes. Variables in dosage, formulation, and research design underscore the need for standardized clinical trials despite encouraging results. Overall, Terminalia arjuna has considerable promise as a natural, safe, and effective myocardial tonic and antihypertensive drug, encouraging its integration into alternative therapy regimens for cardiovascular health.

KEYWORDS: Arjunolic acid, hypertension, cardiac tonic, plant-based therapy, antihypertensive herb, phytochemicals.

INTRODUCTION

The traditional and unconventional systems of treatment have been yielding more than 85% of the therapeutics from a flora source. Plants have been one of the primary sources of medicines from the earliest days of human civilization. Medicinal plants use well ingrained and is a part of history and culture. As a result, it is crucial to value traditional treatment.^[1] However, it pays more attention due to their efficacy, accessible distribution, inflated cost of modern treatments, and cultural inclinations.^[2] The custom of medicinal plants, either as a single medicine or in conjunction, is developing in the health care of human beings. Many people around the world have sought the use of the plant's bark, seeds, root,

berries, leaves, or blossoms for therapeutic purposes because they believe they are less harmful than prescription medications. Thus, there is an incentive to employ them to treat diverse disorders.^[3] Manufacturers have been required to guarantee the addition of excellent extracts utilizing optimal standardization techniques in order to comply with requests for the incorporation of components from therapeutic plants in remedies.^[4] Several studies have proven that the plants by natural means collect and manufacture secondary metabolic products such as glycosides, alkaloids, tannins, and volatile oil compounds and include vitamins and minerals, and have therapeutic characteristics.^[5] However, the precise therapeutic diagnosis of the

numerous plant medicinal ingredients indicated in the old system of medicine continues to present a difficulty till today. Hence, there is an immediate desire to conduct research based on scientific factors such as cultural, phytochemical, and phytopharmacological studies. *Terminalia arjuna* (Roxb.) Wight and Arn. (*T. arjuna*), generally known as “Arjuna,” specifically the bark component, have been utilized in heart failure, ischemia, cardiovascular diseases, plaque accumulation, myocardial necrosis, blood disorders, anemia, and venereal and viral diseases. It is used in the treatment of breaks and ulcers and hepatic and exhibited a low cholesterol level and antibacterial, antimicrobial, antiseptic, antioxidant, antiallergic, antiviral, antifertility, and anti-HIV effects. The stem bark of *T. Arjuna* is rich in aromatic compounds, tannins, nutrients, and flavonoids. These compounds have been proven to exert antioxidant, anti-inflammatory, and lipid-lowering actions, while glycosides are cardiac stimulating.^[6-10] As there is no exposing potent plant element to be investigated to date, the time is ripe for assessing *T. arjuna* stem bark in the overall administration of various diseases. In this latest study, a comprehensive variety of ethnomedical, phytochemical, pharmacological, clinical, and toxicological characteristics of the stem bark of *T. arjuna* was examined. For this objective, datasets such as PubMed, ScienceDirect, and Web of Neuroscience were reviewed. Included were clinical investigations, case reports, and review articles. Ultimately, following the deletion of repetitive content, 60 articles were discovered. *T. arjuna* (Roxb.) Wight and Arn. is an evergreen and everlasting tree, growing 20–30 m above the lowest point, which belongs to the Combretaceae family, comprising around 200 species scattered over the world. Nearly 24 species of *Terminalia* have been found from diverse parts of India. *T. arjuna* is found in India, Burma, Mauritius, and Sri Lanka. It is between 60 and 80 feet tall, with a reinforced trunk, a horizontally distributing crown, and sagging branches.^[11] When viewed from the outside, the stem bark of *T. Arjuna* is straightforward, smooth, and pinkish-gray in color. The bark has a reddish hue and is soft inside. *T. Arjuna* bark is believed to be pleasant, acrid, warming and cooling, stimulating, expectorant, tonic, styptic, antibacterial, purgative, and laxative. Its usage has been encouraged in urine discharge, strangury, leukoderma, sickle cell anemia, hyperhidrosis, asthma, and malignancies. The dietary use of bark powder as an astringent and diuretic is contained in the texts of Charaka.^[12] The usual technique of its administration was to create an alcoholic decoction of its bark stem (asava) or offer it along with clarified butter (ghrita) or along with boiled milk (kshirpak).^[13,14]

PIANT PROFILE

Habitat

Terminalia arjuna is an evergreen, deciduous tree that grows 20 to 30 meters above the ground. It is a member of the Combretaceae family.^[15-17] It can be found in large quantities around ponds and rivers in the Indo-sub-

Himalayan regions of Uttar Pradesh, South Bihar, Madhya Pradesh, Delhi, and the Deccan region. Additionally, Sri Lankan, Burmese, and Mauritian forests have it.^[18]

Ethnomedical factors

Indigenous medical systems have utilized *T. arjuna*'s bark, leaves, and fruits to treat a variety of illnesses.^[21] Sweet, acrid, cooling, heating, aphrodisiac, expectorant, tonic, styptic, antidiysenteric, purgative, and laxative properties are all attributed to the bark. Urinary discharge, strangury, leucoderma, anemia, hyperhidrosis, asthma, and tumors have all been linked to its use. The literature mentions using bark powder as a diuretic and astringent.

PHYTOCHEMISTRY

The bark of *T. Arjuna* was thought to be the most significant component from a therapeutic perspective. As a result, the majority of the early research was restricted to the plant's bark stem. A chemical study of the bark indicated evidence of sugar, tannins (12%), pigment matter, a glycoside, and carbonates made up of calcium, sodium, and quantities of chloride of alkaloid metals.^[21] Eventually the presence of an alkaloid as well as a kind of glycoside was established. The principal chemical contents of several portions of *T. Arjuna* are presented in Table I. The enzyme glycoside was capable of enhancing the force of stroke of the frog cardiac muscle.^[22] An attempt to isolate the glycoside from the soil resulted in the discovery of a natural acid with a high melting point, a phytosterol, an organic ester easily broken down by mineral acids, 12% pigments consisting largely of synthetic compounds, a great deal of calcium and fewer grams of aluminum and magnesium salts, shading matter, and sugar.^[15]

PHARMACOGNOSTIC FEATURES

The bark has a smooth exterior surface and a pinkish interior surface with longitudinal striations.^[23] In April and May, the bark flakes off on its own.^[24] When the adult bark is examined under a microscope, it reveals a cork made up of nine to ten layers of tangentially elongated cells, phellogen that is two to four cells thick, and phelloderm made up of tangentially elongated cells. Ceratenchyma, phloem parenchyma, phloem fibers, and crystal fibers with calcium oxalate rosette crystals make up the wide phloem. The ancient bark contains secondary phloem and periderm.^[24, 25, 26] The leaves have ten to fifteen pairs of nerves, are coriaceous, oblong or elliptic, dull green on the top and pale brown on the bottom, and are frequently unevenly sided. The white, bisexual flowers have linear bracteoles and are placed in spikes. Fruits have five to seven sharp angles or wings and are ovoid or oblong. The wings have upward-curving, oblique lines.^[23] Numerous pharmacological characteristics, such as inotropic, anti-ischemic, antioxidant, blood pressure-lowering, antiplatelet, hypolipidemic, antiatherogenic, and antihypertrophic,

have been demonstrated by several preparations of arjuna stem bark.^[27]



Fig. 1: *Terminalia arjuna*.

EXPERIMENTAL STUDIES

Effects on cardiac hemodynamics, coronary flow, and blood pressure Arjuna bark stem has chronotropic, inotropic, and diuretic qualities.^[9] The aqueous extract has been shown to enhance coronary flow in the Langendorff's rabbit heart preparation.^[28] Recent experimental research supported the previous findings by demonstrating that the aqueous extract of arjuna enhanced the force of cardiac muscle contraction in isolated perfused rabbit hearts, hypodynamic frog hearts in situ, and frog hearts in situ. In an isolated perfused dose-dependent drop in blood pressure, it enhanced coronary flow.^[9] Although the mechanism was not identified, Singh et al. found that an aqueous solution of 70% alcoholic bark extract caused a dose-dependent drop in dogs' blood pressure and heart rate.^[29]

Antioxidant and cardioprotective effect

It has been demonstrated that dried, ground bark increases the rat heart's natural antioxidant molecules and reduces oxidative stress linked to ischemic-reperfusion injury.^[30] It has been proposed that the alcoholic extract of arjuna increases cardiac endogenous antioxidants and activates myocardial heat shock protein 72 in rabbits, providing cardioprotection against oxidative stress linked to myocardial ischemia-reperfusion injury.^[31]

Hypolipidemic and antiatherogenic activity

Previous studies on animals have shown that arjuna bark powder or extract lowers triglyceride (TG) and total cholesterol (TC).^[32, 35] Only the ethanolic fraction significantly reduced lipid levels in hyperlipidemic rats when the hypolipidemic properties of the bark were compared in various solvent fractions (petroleum ether, solvent ether, ethanol, and water). Both in Triton and in rodent models of hyperlipidemia fed a high-fat diet (HFD), solvent ether and ethanolic fractions reduced the plasma levels of lipids. Arjuna fractions at doses of 50–500 µg/ml were found to prevent the oxidative lipid degradation caused by metal ions in rat liver microsomes and human low-density lipoprotein (LDL) in an in vitro experiment. In nonenzymic test setups, these fractions

prevented the formation of superoxide anions and hydroxyl radicals when tested against the production of oxygen free radicals. The order of Arjuna fractions' effectiveness was determined to be ethanol fraction > solvent ether fraction > petroleum ether fraction.^[36]

CLINICAL USES

Rheumatic heart disease

In a double-blind trial, the effectiveness of arjuna in decompensated rheumatic heart disease was investigated. Thirty patients with CHF and rheumatic valvular heart disease received 200 mg of arjuna three times a day. The findings showed a considerable decrease in heart size, a significant improvement in LVEF, and a significant increase in exercise duration.^[37]

Aggregation of platelets

In vitro, 20 patients with angiographically confirmed CAD and 20 age- and sex-matched controls showed that the bark extract had antithrombotic and reduced platelet activation. Interfering with signal transmission or competing with the platelet receptor could desensitize platelets.^[38]

Angina/myocardial infarction

Thirty patients with stable angina or post-infarct angina were tested for the anti-ischemic impact of bark powder (500 mg tds). Along with a considerable drop in systolic blood pressure (SBP), improvement in ECG abnormalities, and a decrease in plasma cortisol and serum cholesterol levels, the authors noted a significant decrease in mean anginal frequency.^[39] In subsequent research, 25 patients with coronary artery disease (CAD) received 500 mg of bark powder twice daily for three months. Six patients showed improvements in exercise tolerance, a decrease in the frequency of anginal attacks and the use of sublingual nitrates, and a decrease in the grade of positive of the treadmill test (TMT) response.^[40]

Thrombotic condition

The methanol extract was found to have high thrombolytic activity (30.57%) in a recent study that examined the in vitro thrombolytic and membrane stabilizing action of four Bangladeshi medicinal herbs, including arjuna. Additionally, it dramatically reduced RBC hemolysis under both heat-induced and hypotonic solution conditions. This demonstrated its mild thrombolytic action, but further investigation is required to identify the secondary metabolites causing the activity.^[41]

TOXICITY AND SIDE EFFECTS OF TERINALIA ARJUNA

The majority of conventional and herbal remedies, such as *T. arjuna*, are well-known for having few adverse effects. There are no known instances of *T. arjuna* toxicity.^[42] With an optimal dosage of 1-2 g daily and 500 mg of the bark extract three times daily for congestive heart failure, *T. arjuna* is most commonly used for the treatment and management of coronary

artery diseases (CAD). Constipation, headaches, and moderate gastritis are among the very minor side effects associated with this medication. There were no indications of haematological, hepatic, metabolic, or renal toxicity following the treatment of this medication for more than two years.^[43,45] According to a study, giving *T. arjuna* to euthyroid mice increased hepatic LPO (lipid peroxidation) and decreased thyroid hormone levels. Because this plant extract carries a danger of developing hypothyroidism and hepatotoxicity, caution must be exercised when taking it.^[46-51]

CONCLUSION

The hunt for efficient, secure, and easily available treatment options is fueled by the fact that hypertension remains a significant worldwide health concern. Based on mounting scientific data, *Terminalia arjuna*, a well-known Ayurvedic medicinal plant, shows great promise as a cardiac-tonic and antihypertensive herb. Numerous pharmacological activities, including antioxidant activity, vasodilation, improved endothelial function, lipid regulation, and improved myocardial performance, are facilitated by its rich phytochemical profile, which includes arjunolic acid, flavonoids, triterpenoids, and glycosides. A natural, all-encompassing, and secure approach to cardiovascular care is provided by *Terminalia arjuna*, a promising plant-based option for supplementary hypertension medication. Its incorporation into contemporary treatment approaches may significantly aid in the control of hypertension and the advancement of heart health.

RESULT

Terminalia arjuna has a beneficial impact on blood pressure regulation and heart health, according to research from several animal studies, lab testing, and human clinical trials. Natural substances found in the plant, including as flavonoids, arjunolic acid, and antioxidants, assist strengthen the heart and blood arteries.

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