2026 Volume: 02 Issue: 03 www.ijrpa.com ISSN 2456-9995 Review Article

International Journal Research Publication Analysis

Page: 01-12

FORMULATION AND EVALUATION OF TERMINALIA ARJUNA-BASED HERBAL TABLET FOR THE MANAGEMENT OF ANGINA PECTORIS

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Article Received: 5 February 2026
Article Revised: 25 February 2026
Published on: 18 March 2026

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DOI: https://doi-doi.org/101555/ijrpa.2378

ABSTRACT:

One of the main clinical signs of coronary artery disease is angina pectoris, which results from the myocardium receiving less oxygen. Triterpenoids, flavonoids, glycosides, and tannins are among the bioactive components of Terminalia arjuna, a well-known cardioprotective plant in Ayurveda, which together give it antioxidant and cardiotonic qualities. The creation and assessment of a herbal tablet made from standardized Terminalia arjuna bark extract for the treatment of angina pectoris is the main goal of this study.Plant material authentication, extraction and standardization, phytochemical screening, and the creation of an appropriate tablet formulation with the right excipients are all part of the research project.The prepared tablets were evaluated for flow characteristics, hardness, friability, uniformity, disintegration, and dissolution behavior both before and after compression. The extract's capacity to enhance cardiac markers, lower oxidative stress, and maintain myocardial integrity was further shown by in-vitro antioxidant assessment and in-vivo pharmacological evaluation. Overall, the prepared Terminalia arjuna tablets demonstrated promising cardioprotective and antianginal potential along with acceptable pharmaceutical quality. These results lend credence to the use of standardized herbal formulations as more affordable, safe, and efficient long-term treatments for angina pectoris. Future research on advanced delivery systems, clinical evaluation, and bioavailability studies may improve therapeutic efficacy even more.

KEYWORDS: Cardioprotective activity, antioxidant activity, phytochemical screening, precompression parameters, post-compression evaluation, myocardial protection, anti-anginal effect, Angina pectoris, Terminalia arjuna, and herbal tablet formulation.

INTRODUCTION

One of the main causes of death in the world is cardiovascular disease. Among these conditions, angina pectoris is a prevalent one that causes discomfort or pain in the chest as a result of inadequate blood flow to the heart muscles. The coronary arteries, which provide the heart with oxygen-rich blood, typically narrow, resulting in decreased blood flow.

When the heart muscle needs more oxygen than the coronary arteries can provide, angina pectoris usually results. Atherosclerosis, or the accumulation of fatty deposits or plaques in the arterial walls, is frequently the cause of this condition. These plaques limit blood flow to the heart by decreasing the diameter of arteries.

Chest pain, tightness or pressure in the chest, shortness of breath, exhaustion, sweating, and dizziness are common symptoms of angina pectoris. These symptoms are typically alleviated by rest or medication and can be brought on by physical activity or emotional stress.

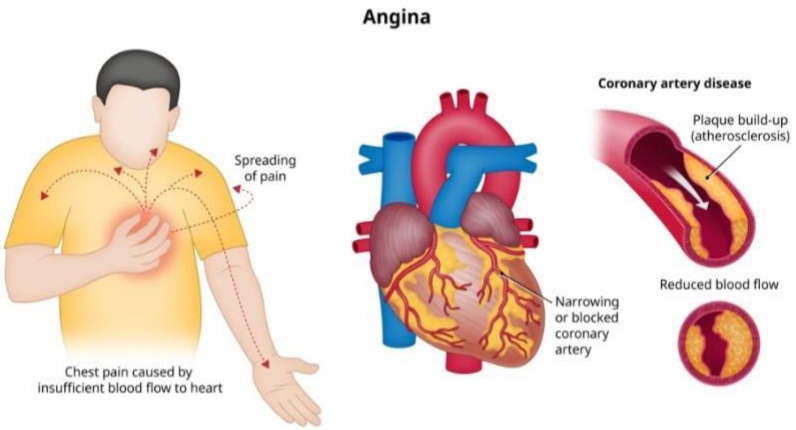

Figure 1.1: Angina pectoris.

Angina pectoris can be treated with a number of conventional medications, such as beta-blockers, calcium channel blockers, and nitrates. These drugs lessen the strain on the heart muscle and enhance blood flow to the heart. However, long-term use of synthetic medications may result in side effects like gastrointestinal problems, headaches, dizziness, and hypotension. These drawbacks have led to a rise in interest in using herbal remedies to treat cardiovascular conditions.

Compared to synthetic drugs, herbal remedies are thought to be safer and more affordable. For centuries, traditional medical systems have employed a variety of medicinal plants with cardioprotective qualities.

One such medicinal plant that is frequently used in Ayurveda to treat heart conditions is Terminalia arjuna. This plant's bark is full of bioactive substances with cardioprotective, anti-inflammatory, and antioxidant properties. Due to these advantageous qualities, Terminalia arjuna has drawn a lot of interest for the creation of herbal remedies meant to treat cardiovascular conditions like angina pectoris.The creation and assessment of herbal tablets with Terminalia arjuna extract for the treatment of angina pectoris is the main goal of this study.

Types:

There are different types of angina.

1. Stable angina
2. Unstable angina
3. Varient angina

1. Stable angina- The most prevalent type of angina is stable angina. It typically occurs during exertion, also known as activity. Rest or angina medication make it go away. Angina may be the cause of pain that appears when you walk uphill or in cold weather. Angina that is stable is predictable. Usually, it resembles earlier chest pain episodes. Usually, the chest pain subsides after five minutes or less.

2. Unstable angina- A medical emergency is unstable angina. Unstable angina happens while at rest and is erratic. Alternatively, the pain is getting worse and requires less physical exertion. Compared to stable angina, unstable angina is usually more severe and lasts for at least 20 minutes. Both rest and the standard angina medications do not relieve the pain. The heart doesn't get enough oxygen if the blood flow doesn't improve. There is a heart attack. Angina that is unstable is dangerous and requires immediate medical attention.

3. Varient angina- Another name for variant angina is Prinzmetal angina. Coronary artery disease is not the cause of this kind of angina. It is brought on by an artery spasm in the heart. Blood flow is momentarily reduced by the spasm. The primary symptom of variant angina is severe chest pain. It usually happens in cycles, usually overnight and at rest.

Angina medication may help reduce the pain.

S.No.	Drug classes	Example of FDA approved drugs	Mechanisms of action of drugs
1.	Nitrates	Nitroglycerin, Isosorbide dinitrate	Dilates coronary arteries and reduces myocardial oxygen demand by venodilation.
2.	Beta-blockers	Propranolol, Metoprolol	Decreases heart rate and contractility, thereby reducing oxygen demand of the heart.
3.	Calcium channel blockers	Verapamil, Diltiazem	Inhibit calcium Ion influx in cardiac and smooth muscle cells causing vasodilation and reduced cardiac workload.
4.	Potassium channel activators	Nicorandil	Opens potassium channels and causes vasodilation of coronary arteries.

Causes of Angina Pectoris:

1. Coronary artery disease is typically the cause of angina.
2. The heart receives oxygen-rich blood from the coronary arteries. The arteries are effectively narrowed when cholesterol builds up on the artery wall and forms hard plaques.
3. Additional factors that raise the risk of plaque accumulation include smoking and artery damage.
4. It is more difficult for oxygen-rich blood to get to the heart when the arteries constrict. Additionally, plaques can fragment and form clots that obstruct the arteries.
5. The heart muscle cannot function correctly if blood cannot carry oxygen to the heart. Angina is brought on by this.

Risk factor:

1. Smoking , Stress
2. Lack of physical activity
3. High cholesterol

Medicinal Plants :Arjuna Tree

The Combretaceae family includes the large, deciduous, evergreen Arjuna tree (Terminalia arjuna), which is indigenous to India. It is regarded as one of the most significant medicinal plants for cardiovascular health and has been utilized in traditional Ayurvedic medicine for over 2,500 years. In Ayurveda, Arjuna is classified as a “cardiotonic” herb, which means it strengthens the heart muscles and improves circulation.

The tree, whichh can reach heights of 20 to 30 meters, is frequently found in sub-Himalayan regions and along riverbanks. The most significant component used for medicinal purposes is

its bark, or 3. Fruits: They contain flavonoids and tannins and are occasionally used in Ayurvedic formulations.

Arjuna chaal. The bark tastes somewhat bitter, is smooth, and has a grayish hue. It is full of bioactive substances with cardioprotective, anti-inflammatory, and antioxidant qualities.

In ancient Ayurvedic texts like the Charaka Samhita and Sushruta Samhita, Arjuna is mentioned as a remedy for Hridroga (heart diseases), Daurbalya (weakness), and Vranaropana (wound healing). Many of these traditional uses have solid pharmacological underpinnings, according to recent scientific research.

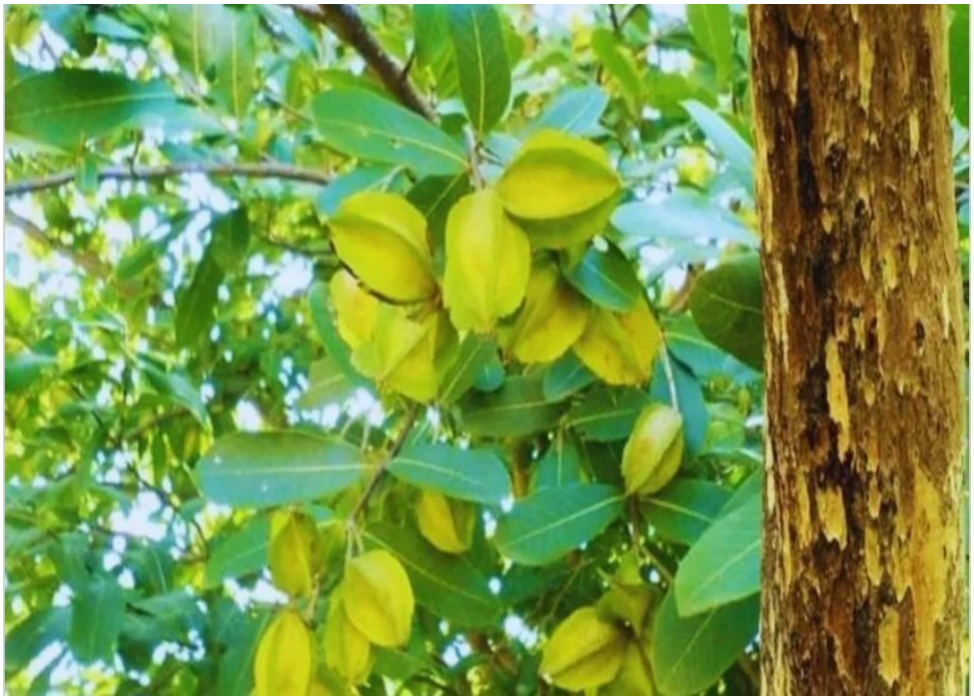

Figure 2.1: Terminalia arjuna plant.

Plant Profile: Arjuna (Terminalia Arjuna)

Common Name: Arjuna, Arjun Tree, White Marudah

Botanical Name: Terminalia arjuna

Family: Combretaceae

Origin:

India is the native home of the Arjuna plant (Terminalia arjuna). Throughout the Indian subcontinent, it is frequently found in sub-Himalayan regions and beside rivers. In addition to growing naturally in Bangladesh, Sri Lanka, and Myanmar, the plant has been brought to some regions of Southeast Asia and Africa because of its decorative and medicinal qualities.

Description:

General Description:

The large, evergreen deciduous arjuna tree can grow to a height of 20 to 30 meters. It is wellknown for its robust trunk, spreading crown, and characteristic thin-flake-peeling bark.

Bark: The smooth, grey to pinkish-brown bark is frequently exfoliating. In traditional medicine, particularly Ayurveda, the reddish inner bark is highly prized.

Leaves: Simple, oblong (10–15 cm long), opposite or sub-opposite leaves have a dark green upper surface and a paler underside. They have a short petiole and are thick and leathery.

Flowers: During the summer (March–June), terminal panicles produce tiny, white to yellowishgreen flowers. Bees and other pollinators are drawn to the flowers because of their rich nectar and subtle fragrance.

Fruits: The fruit is a 2.5–5 cm long, woody, fibrous drupe with five distinct wings. September through November is when it ripens.

Parts Used:

1. Bark: The most significant and frequently utilized component. It is prized for its woundhealing, antioxidant, and cardioprotective qualities.
2. Leaves: Traditional medicine uses leaves for their anti-inflammatory and antibacterial properties.
3. Fruits: They contain flavonoids and tannins and are occasionally used in Ayurvedic formulations.
4. Seeds: Known for their antioxidant properties, they are used less frequently.

Figure2.2:Terminalia arjuna- Leaves, Fruits, Seeds, Bark.

Table 2.1: Chemical constituents present in different parts of Terminalia arjuna:

S. No.	Plant parts	Phytochemicals
1.	Bark	Terpenoids- Arjugenin, Arjunic acid, Arjungenin, Terminic acid, Arjunolic acid. Glycosides- Arjunetin, Arjunoside I & II, Arjunolone, Arjunolitin, Terminoside A, Terminic acid.
2.	Leaves	Alkaloids, cardiac glycosides, flavonoids, tannins, phenols.
3.	Roots	Arjunoside, Arjunolic acid, Terminic acid, Arjunic acid .
4.	Fruits	Arjunic acid, Hentriacontane, cerasidin, while Bark has tannins, flavonoids, glycosides52. Luteolin in leaves and roots contained Triterpenoids and Glycosides.

Traditional uses:

Terminalia arjuna has been used extensively in traditional Ayurvedic medicine to treat a variety of heart-related ailments. It is known to enhance blood circulation, control blood pressure, and fortify the heart muscles. It is also used to treat digestive issues, wounds, and fractures.

Literature review:

1. Patel et al. (2025):Patel and colleagues explored tablet formulations containing standardized Terminalia arjuna bark extract for managing angina symptoms. Their study focused on optimizing binder concentration, disintegration time, and compression force To improve tablet uniformity and bioavailability. Pharmacological testing showed reduced chest discomfort, improved coronary perfusion, and enhanced antioxidant enzyme levels, validating Arjuna’s cardioprotective potential.
2. Sharma et al. (2025): Sharma formulated a polyherbal tablet using T. arjuna with supportive herbs like Punica granatum and Piper longum. Physicochemical analysis confirmed acceptable hardness, friability, and weight uniformity. In vivo testing revealed improvements in myocardial oxygen demand and decreased cardiac biomarkers (LDH, CK-MB), demonstrating strong cardiotonic activity.
3. Verma et al. (2025):Verma developed a chewable Arjuna tablet using spray-dried standardized bark extract. Tablet evaluation showed rapid disintegration, acceptable friability, and improved patient acceptability. In vivo rat models exhibited reduced ischemic ECG changes and lowered serum troponin, supporting the chewable format for quicker symptom relief.

4. Kaur et al. (2024):Kaur investigated phytochemical standardization of Terminalia arjuna extracts using HPTLC and HPLC fingerprinting. Standardized batches showed consistent Arjunolic acid content and enhanced antioxidant potency. Authors emphasized the need for pharmacopeial specifications for herbal angina formulations.
5. Mehta et al. (2024): Mehta assessed the effects of T. arjuna tablets on endothelial dysfunction in early angina patients. HPLC analysis confirmed high arjunolic acid content. Clinical observations reported improved vascular dilation, reduced arterial stiffness, and enhanced heart function, highlighting the importance of phytochemical standardization.

METHODOLOGY:

1.Collection of Plant Material

A botanist verified the authenticity of the Terminalia arjuna bark after it was gathered from a suitable location. To get rid of dust and contaminants, the gathered bark was thoroughly cleaned. The active ingredients were then preserved by drying it in the shade.

2.Preparation of Powder

A mechanical grinder was used to turn the dried bark into a coarse powder. To achieve a consistent particle size, the powdered material was subsequently run through a sieve.

3.Extraction Process

The Soxhlet extraction method was used to extract the powdered bark. The extraction solvent was ethanol.

Using this method, the Soxhlet apparatus was filled with. powdered plant material, and the solvent was continuously heated. The plant material's active compounds were extracted by the solvent. A semi-solid extract was then produced by concentrating the extract through evaporation.

Formulationof Herbal Tablet :

The herbal tablets were prepared using the wet granulation method.

S. No.	Ingredients	Role
1.	Terminalia Arjuna extract	Active ingredient
2.	Mycrocrystalline cellulose	Diluent
3.	Starch	Binder
4.	Magnesium stearate	Lubricant
5.	Talc	Glident

Procedure:

1. The required amount of Terminalia arjuna extract was mixed with diluent.
2. A binder solution was added to form a wet mass.
3. The wet mass was passed through a sieve to produce granules.
4. The granules were dried and mixed with lubricants.
5. The mixture was compressed into tablets using a tablet compression machine.

Evaluation of Tables:

The formulated tablets were evaluated using standard pharmaceutical tests.

Weight variation test - Twenty tablets were randomly selected and weighed individually. The average weight was calculated and compared with pharmacopeial limits.

Hardness test - Tablet hardness was measured using a hardness tester to determine the mechanical strength of the tablets.

Friability test - Friability was determined using a friabilator. The tablets were rotated for a fixed number of cycles and the percentage weight loss was calculated.

Disintegration test - The disintegration time of the tablets was determined using a disintegration test apparatus.

Dissolution study - Dissolution testing was carried out using a dissolution apparatus to determine the release rate of the active compounds from the tablets.

CONCLUSION:

The present study focused on the formulation and evaluation of herbal tablets containing Terminalia arjuna extract for the management of angina pectoris. The prepared tablets were evaluated for various pharmaceutical parameters including hardness, friability, weight variation, and disintegration time.

The results indicated that the formulated tablets met acceptable pharmaceutical standards and possessed suitable characteristics for oral administration. The cardioprotective and antioxidant properties of Terminalia arjuna make it a promising herbal drug for the treatment of cardiovascular disorders.

Further studies such as clinical trials and stability studies are required to confirm the therapeutic efficacy and long-term safety of this herbal formulation.

Future Prospective:

1. To confirm the effectiveness and safety of the prepared herbal tablets in human subjects, more pharmacological and clinical research is required.
2. To ascertain the absorption, distribution, metabolism, and excretion profile of the active ingredients, bioavailability and pharmacokinetic studies ought to be carried out.
3. Using nanotechnology or innovative drug delivery methods (such as sustained-release formulations or nano-tablets) may improve Terminalia arjuna's therapeutic effectiveness.
4. Synergistic effects can be investigated by combining formulations with other cardioprotective herbs, such as Withania somnifera, Ocimum sanctum, and Allium sativum.
5. To guarantee constant quality and therapeutic action, active phytoconstituents like arjunolic acid, arjunic acid, and arjunoside must be standardized.
6. For long-term storage and safety evaluation, toxicological and stability studies ought to be prolonged.
7. In comparison to current synthetic anti-anginal medications, the formulation can be further assessed for patient acceptability, palatability, and cost-effectiveness.
8. Its entry into the herbal pharmaceutical market may be facilitated by the development of commercial-scale production and regulatory validation.

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