

# Terminalia Arjuna: An Indigenous Ancient Drug for Cardio Protection

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Submitted: 05-02-2022

Accepted: 20-02-2022

## ABSTRACT

Now a days herbal plants are used worldwide for treatment because of the less side effect and cost of treatment is also low. The terminalia arjuna Herbal plant contains various phytoconstituents which are used to treat various acute and chronic diseases since ancient times. Main objective of this review paper was to explore the various therapeutic aspects of terminalia arjuna. terminalia arjuna is recognized as major sources of chemical constituents to treat heart diseases. Cardiovascular diseases on the top which causes majority of death worldwide. These cardiovascular diseases arise mostly due to sedentary lifestyle, food habits, pollution, etc. terminalia arjuna is also used to treat lipid disorder, diabetes, any type of skin infection, purify blood, reduces vata from body, anti-inflammatory, antioxidant, etc. terminalia arjuna belongs to combretaceae family .it contains arjunic acid, arjunolic acid, arjungenin , arjunone , arjunolone and luteolin, gallic acid, ellagic acid, phytosterols these are the major phytoconstituents found in arjuna bark.

**KEYWORDS** :Terminalia arjuna, cardio protection, phytoconstituents.

## I. INTRODUCTION

Arjuna is an ayurvedic remedy that has been mentioned in ancient Vedic text, belonging to combretaceae family. It is used in both the formulation such as traditional and modern due to their effectiveness, cultural preferences and less cost than synthetic medicine. (1). due to increasing demand to the herbal medicine the use of herbal drug increases from 2.5 to 12 %). If plants naturally contain secondary metabolites such as tannins, alkaloids, glycoside, minerals, vitamins, volatile oils then they also have the medicinal properties. Flavonoids exerts antioxidant, anti-inflammatory and lipid lowering effect while glycosides are cardiotonic in nature. (5). we mostly use the bark

of arjuna plant and powder of that bark is used in case of severe chest pain caused by insufficient blood supply to the heart. (2, 3). The phytoconstituents present in the bark shows anti carcinogenic and antimutagenic activity. (7,8,9,10). The bark is antipyretic, cardiotonic, astringent, anti-dysenteric, tonic, lithotriptic and also gives relief in hypertension and in liver cirrhosis. (4).

## ROLE OF MEDICINAL PLANTS

Medicinal plants are rich source of phytoconstituents which can be used in the development of various herbal, synthetic, semi synthetic formulations. Each part of plant contains various phytoconstituents so the part of plant we are using is very important to choose wisely. And each part of plant is used in different diseases. These plants are less toxic, have better cultural acceptability, better compatibility, adaptability with human body and possess less side effects if taken properly. These plants treat the root cause of diseases and not only the symptoms like modern medicine so the demand of herbal medicine is increasing now a days. Some of the drugs believed to be obtained from plants are vinblastine from vinca, quinine from cinchona, morphine from opium, artemisinin from artemisia etc. Medicinal plants have provided mankind a large variety of potent drugs to alleviate infections. Medicinal herbal plants are used in case of ulcer, boils, diarrhoea, asthma, liver diseases, conjunctivitis, cancer, blood infection, kidney diseases etc.

## TAXONOMY OF TERMINALIA ARJUNA

Botanical classification is most scientific and comprehensive. Medicinal plants are identified according to plant part used, habitat, therapeutic value etc, so the taxonomy of T. arjuna is as following: (19, 20)

<b>Kingdom</b>	<b>Plantae</b>
<b>Division</b>	<b>Magnoliophyte</b>
<b>Class</b>	<b>Magnoliopsida</b>
<b>Order</b>	<b>Myrtales</b>
<b>Family</b>	<b>Combretaceae</b>
<b>Genus</b>	<b>Terminalia</b>
<b>species</b>	<b>T. arjuna Roxb.</b>

#### VERNACULAR NAMES OF TERMINALIA ARJUNA

English	Arjun
Hindi	<b>Arjuna, Arjun</b>
Assamese	<b>Arjun</b>
Irula	<b>Mathi</b>
Kannada	<b>Nirmatti, Atumaruthu, Neermaruthu</b>
Malayalam	<b>Vellamathi, Nirmarutu, Aatumaruthu</b>
Manipuri	<b>Maiyokpha</b>
Tamil	<b>Vella Maruda, Vella Maruthu, Marutu</b>

#### BOTANICAL DESCRIPTION OF T. ARJUNA

##### Biological Source

Arjuna consist of dried stem bark of plant known as Terminalia Arjuna Rob, belonging to family combretaceae. it contains not less than 0.02 % or arjungenin on dried basis.

##### Habitat –

Plant of arjuna is found and very common in Baitul in Madhya Pradesh and Dehradun, Uttarakhand.

T. Arjuna is large perineal, naturally growing plant in dense forest. The length of plant is up to 60 to 100 feet long. It is evergreen tree with flowers which are white with short axillary spikes and each flower consist of 10 stamens and an ovary which is disk clothed with yellow or reddish hair. Leaves are dull green above and pale brown beneath, simple, borne sub-opposite coriaceous, often crenulating, oblong or elliptic. Leaves measures 10-15 cm long and 4-7 cm broad. It has horizontally spread branches. Bark is thick, soft and smooth grey, red colour from inside, irregular sheets, curved and rather flat pieces. Bark of the plant shows presence of single layered epidermis with hair like projections and few scattered lenticles. Secondary phloem and periderm are present in old bark. Petioles are arranged with one or two prominent glands at the top, immediately below the leaf. fruit is 3-4 cm long, glabrous with 5 hard angles or wings. The wings lines are curved upward and oblique. Fruit is drupe and often notched near the top. Arjuna flowers between march to June and fruits between September to November. Seeds are hard germination 50 to 80

days. Arjuna root is superficial, shallow, and spread radially along stream banks.

#### GEOGRAPHICAL DISTRIUTION

The tree is deciduous found in dry hill areas and common in Indian peninsula, distributed throughout Indo sub-Himalayan region of utter Pradesh, south Bihar, Madhya Pradesh, it is grown by side of streams and very common in chotta Nagpur region. The plant is cultivated near ponds and rivers. It is also fund in forest of shri Lanka, Burma and Mauritius.

#### MACROSCOPY

Color color of outer side is greyish brown and inner side of bark is reddish brown.  
 Surface outer surface – smooth  
 inner surface – finely longitudinally striated.  
 Odour characteristic.  
 Taste Bitter, astringent.  
 Shape flats.  
 Fracture inner part – short  
 outer part – laminated.

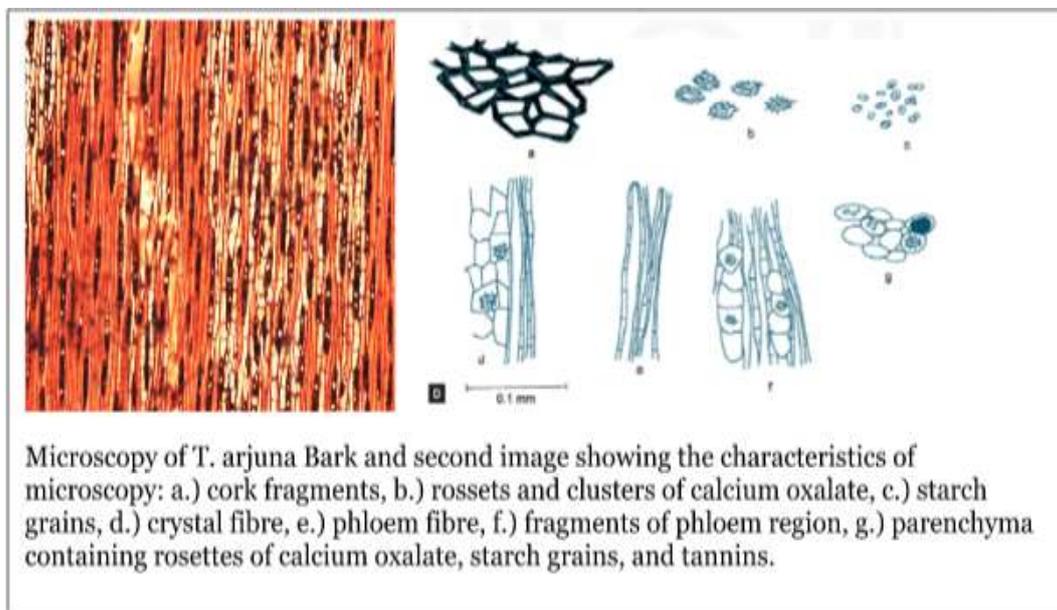
#### MICROSCOPY

Cork consists of few layers of tangentially running and radially elongated cells, phellogen, 2-4 celled thick, phelloderm narrow, consisting of 4-6 rows of tangentially elongated and radially arranged cells. Phloem, very broad, traversed by uniseriate medullary rays running straight and parallel, occasionally becoming slightly curved near the rosette crystals; groups of phloem fibers, lignified, thin walled, tangentially arranged, associated with idioblast containing clusters and

rosettes of calcium oxalate while some cells contain starch grains.

**POWDER MICROSCOPY –**

In powder microscopy of arjuna bark shows the uniseriate medullary rays running straight, parallel, occasionally becoming slightly curved, some cells contain starch grains.



**CHEMICAL CONSTITUENTS –**

Arjuna contains 15 % of tannins. the major phytoconstituents are triterpenoids, polyphenols, flavonoids, tannins, sterol and minerals. It also contains triterpenoid saponins, arjunolic acid, arjunic acid, arjungenin. In addition, it contains beta sitosterol, ellagic acid and arjunic acid. The crystallizable compound reported are arjunine and arjunetin. Arjuna bark also shows presence of coloring matter, sugar, glycoside and carbonate of calcium, sodium and traces of chloride of alkali metals. Glycosides are capable of increasing force of contraction of heart. Various organic solvents like ethanol, hexane, chloroform, benzene etc. are used to isolate various chemical constituents.

• **FLAVONOIDS/ FLAVONES –**

High level of flavonoids is present in arjuna bark such as arjunolone, flavones, bicalein, quercetin, kaempferol. luteolin possesses antimutagenic and antibacterial properties. chemical name of arjunolone is 6,4 – dihydroxy-7-methoxy flavone and chemical name of bicalein is 5,6,7-trihydroxy flavone.

• **TERPENOIDS AND GLYCOSIDES –**

Arjunin is an oleanane triterpenoid and a lactone arjunetin was isolated bark using benzene and alcoholic extracts. Arjungenin and arjunic acid is found in bark stem of the plant. Glycosides are also present in bark stem these are arjun glucoside I and arjun glucoside II. Terminic acid was also isolated from the n-hexane extract of arjuna heartwood. Arjunaphanoloside is a naphthanoloside possessing antioxidant activity that has been isolated from the bark.

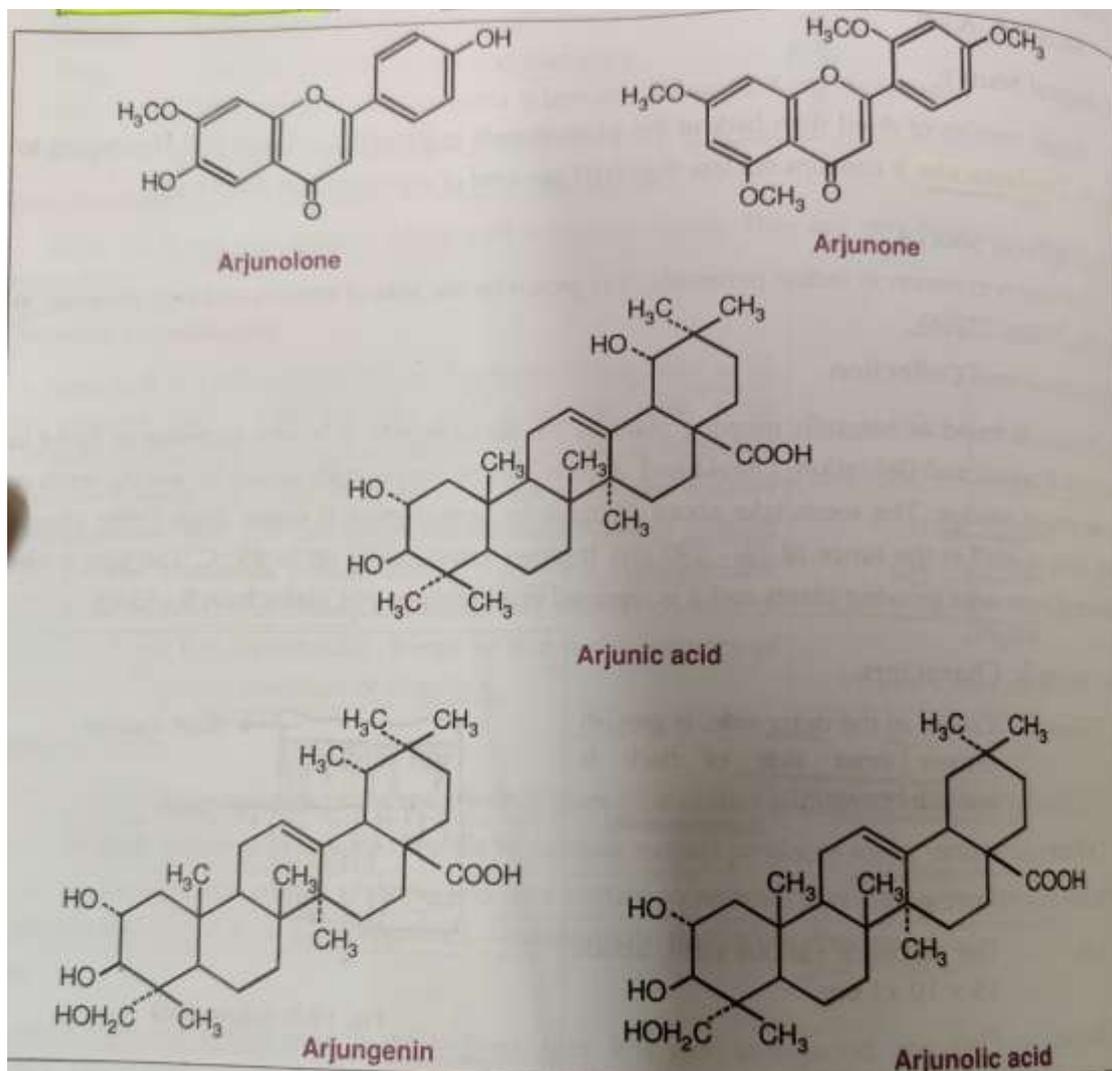
• **TANNINS –**

Many tannins have been isolated from the bark of arjuna and some of the hydrolyzed tannins are pyrocatechols, punicallin, punicalagin, terchebulin, castalagin was isolated twenty types of tannins and related type of compounds from its bark. Tannins are basically used for enhance the synthesis of nitric oxide and relax vascular segments precontracted with norepinephrine. Tannins are also responsible for their astringent, wound healing and anti-microbial activity.

• **MINERALS –**

Dwivedi et al., was reported that the bark contains large amounts of magnesium, calcium, zinc, copper, and silica.

## STRUCTURES



## PHYSICO CHEMICAL ANALYSIS

### • TOTAL ASH –

This method is designed to measure the total amount of material remaining after ignition. This includes both physiological ash which is derived from plant tissue itself, and non-physiological ash which is residue of the extraneous matter adhering to plant surface.

### • PROCEDURE-

Place about 2-4gm of powdered T. arjuna bark in tarred china dish. After that it was subjected to muffle furnace at a temp of 500-600 degree Celsius. weight was taken when it becomes red hot and then cooled. constant reading was taken at an interval of two hours.

### • ACID INSOLUBLE ASH –

It is the residue remaining after boiling the total ash with dilute HCL and igniting the remaining insoluble matter. This measures the amount of silica present, especially as sand and siliceous earth.

### • PROCEDURE –

2gm of powdered T. arjuna bark was taken and mixed with 25 ml of HCL. Total ash was boiled for 5 min and diluted with 25ml of HCL. Insoluble matter was collected on an ashless filter paper. Filter paper was washed with hot water. Crucible was ignited and then cooled. after that it

was kept in a desiccator. Residue was weighed and acid insoluble ash of drug was calculated.

• **DETERMINATION OF MOISTURE CONTENT –**

It is used to determine the water content by removing moisture and then by measuring weight loss.

• **PROCEDURE –**

2gm of powdered T. arjuna bark was taken in tarred china dish. Then powder was dried in an oven at 100–105-degree Celsius followed by cooling in desiccator. After that the loss of moisture content was recorded. The procedure was continued for at least two concurrent reading.

• **SULFATED ASH –**

Test is used for determining the content of inorganic impurities in an organic compound.

• **PROCEDURE –**

2gm of powdered T. arjuna was taken in silica crucible and 3ml of sulfuric acid was added to it. The powder was incinerated by gradually increasing the heat until it becomes free from

carbon and then residue was cooled in desiccator. Ash was weighed and the percentage of sulphated ash was calculated.

• **WATER INSOLUBLE ASH –**

The part of total ash remaining after treatment with water under specific conditions.

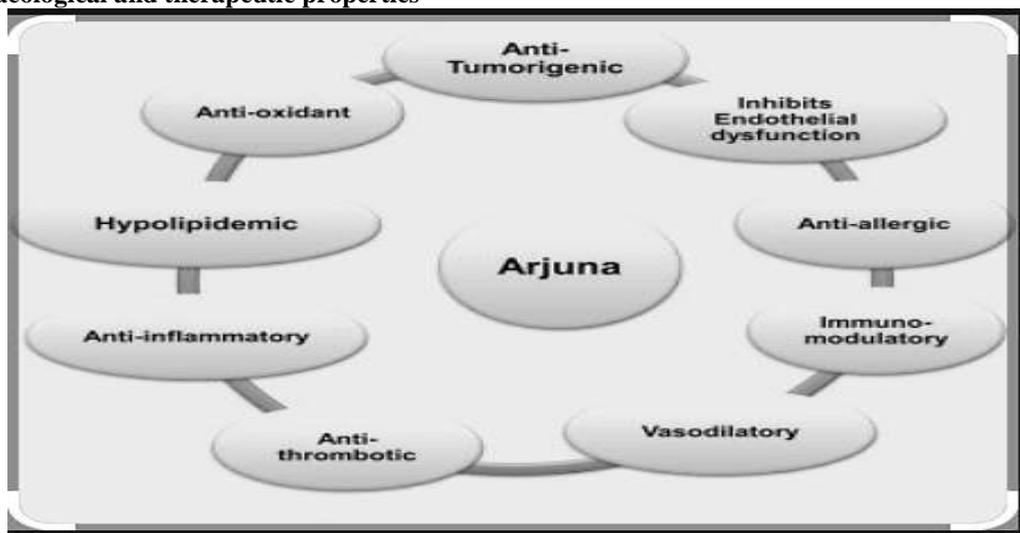
• **PROCEDURE –**

2gm of powdered T. arjuna bark was taken in silica crucible and 25ml of water was added to it. The mixture was boiled. After that insoluble matter was filtered on an ashless filter paper. The residue was ignited in crucible and then cooled. The residue was weighed and water insoluble ash was calculated.

• **Determination Of Alcohol Content –**

2 gm of powdered T. arjuna bark was taken in a tarred silica crucible. The powdered drug was incinerated until it becomes carbon free. The residue was cooled and kept in a desiccator. The ash was weighed and the percentage of total ash was calculated.

**Pharmacological and therapeutic properties -**



**Clinical Uses –**

Since time immemorial, arjuna has been an herb of choice in dealing with various forms of heart related disorders. It is very helpful in nurturing the heart muscles, in maintenance of proper heartbeat, proper contraction and relaxation of the heart muscles. Also, very effective in constricting the blood capillaries which is important for working of heart and in increasing the blood density. It is also helpful in dilation of

blood vessels and effective in coagulation of blood in case of any injuries and for maintaining proper thickness of the blood.

**Mechanism -**

Improvement of cardiac muscle function and subsequent improved pumping activity of the heart seems to be the primary benefit of Terminalia. It is thought the saponin glycoside might be responsible for the inotropic effect of

Terminalia, while the flavonoids and OPCs provide free radical antioxidant activity and vascular strengthening. (11)

Recently, two new cardenolide cardiac glycosides were isolated from the root and seed of Terminalia. The main action of these cardenolides is to increase the force of contraction by means of a rise in both intracellular sodium and calcium.

#### Local Action -

Arjuna, is one of the best blood coagulants. It is wide used in stopping external haemorrhages as it has the power to coagulate blood and constrict the blood vessel locally to stop the blood let. It is applied on the wound to get the instant results. Arjuna is also one of the most powerful herbal supplements that are known for its healing powers. Good prognoses have been seen in cases of wounds and injuries especially in cases like bone, ligaments and cartilaginous injuries. It is also applied on the wounds to attain early healing and recovery from it.

#### □ Digestive system:

It is also beneficial in maintaining proper condition in our digestive tract. Due to its astringent properties, it is very helpful in treating up of the diarrhoea and dysenteric condition in the body. It regulates the peristaltic movements in the body and does not allow dehydration leading to lose stools. Arjuna is Kashaya in nature that is extremely helpful in condition like bleeding piles and dysentery. It is a general health tonic and a good reedy in improving liver condition especially cirrhosis of liver.

#### ·Respiratory system:

Arjuna is also considered beneficial in expelling out the extra amount of mucus that somehow gets accumulated in the respiratory tract. It is also helpful in preventing the accumulation of the mucus thereby helpful in toning up of the respiratory tract. It is also helpful in keeping away with the infections in the lungs and also facilitates the increase in the lung capacity.

#### □ Nervous system:

It is also considered a good nervine tonic. Though it is a matter of research but good results have been seen. It provides strength to the nervous system and also strengthens the reflexes.

#### □ Reproductive system:

Arjuna being astringent in nature helps in thickening of the serum and the sperm that is very essential for the proper fertilization of the ovum. It is also helpful in increasing the sperm count and also is helpful in increasing the overall stamina of the body.

#### □ Endocrinal system:

It is also very helpful in regulating the hormonal system of the body. It is extremely helpful in maintaining the proper stimulation to the endocrine glands.

#### □ Excretory system:

It is helpful in polyurea condition and is also helpful regularizing the increased urine frequency. It helps in toning up of urinary tract. It is also helpful in fading away the infection in the body.

#### □ Skin:

It is very useful in treating all kinds of skin related problems. Due to its cold potency, it is highly recommended in skin ailments. Ailments like eczema, itching, rashes scars and serious skin conditions like psoriasis can also be treated with the regular use of Arjuna.

Studies were conducted to establish the effects of Terminalia Arjuna bark extract on apoptosis of human hepatoma cell line HepG2. The action of Terminalia arjuna (T. arjuna) extract on human hepatoma cell line (HepG2) and its possible role in induction of apoptosis was conducted and was found that T. Arjuna induced cytotoxicity in HepG2 cells in vitro. Apoptosis of HepG2 cells may be due to the DNA damage and expression of apoptotic proteins. Depletion of GSH may be involved in the induction of apoptosis of HepG2 cells.

#### □ General action:

Arjuna has also been found effective as an antioxidant as it has certain properties that acts as scavengers in scavenging according to various studies conducted in searching the reason for such a property. Researches were conducted to evaluate the antioxidant properties of Arjuna and then compare it with another antioxidant i.e., vitamin E. for these random controlled experiments were conducted.

#### Clinical studies -

Angina/myocardial infarction

The anti-ischemic effect of bark powder was evaluated in 30 patients of stable angina/post-infarct angina (500 mg tds). The authors observed that the mean anginal frequency decreased significantly, along with a significant decrease in systolic blood pressure (SBP), improvement in ECG changes, and reduction in plasma cortisol and serum cholesterol levels. [12]

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Recently, arjuna has also been shown useful in improving cardiovascular endurance and in lowering SBP in normal healthy subjects. [13]

#### Cardiomyopathy

In addition to its anti-ischemic property, arjuna was found to reduce LVM and improve LVEF.[18] A recent observational study revealed that when patients of dilated cardiomyopathy with reduced LVEF received arjuna in addition to their standard therapy, there was a significant improvement in left ventricular parameters as well as functional capacity.[14]

#### Platelet aggregation

The bark extract has been found to decrease platelet activation and possess antithrombotic properties in vitro in 20 patients of angiographically proven CAD and 20 age- and sex-matched controls. The possible mechanism could be by desensitizing platelets by competing with platelet receptor or by interfering with signal transduction. [15]

#### Lipoprotein(a)

A significant reduction in lipoprotein(a) levels amounting to 24.71% following the administration of arjuna in a patient of  $\beta$ -thalassemia associated with hyperlipoproteinemia and metabolic syndrome has been reported. [16]

#### Endothelial dysfunction

In a double-blind, placebo-controlled, cross-over study involving 18 healthy male smokers and an equal number of age-matched non-smoker controls, it was observed that the hydroalcoholic extract of bark when given for 2 weeks led to significant regression of the endothelial abnormality amongst smokers.[17]

#### Thrombotic condition

In a recent study done to investigate the in vitro thrombolytic and membrane-stabilizing action of four Bangladeshi medicinal plants including arjuna, the methanol extract was found to possess significant thrombolytic activity (30.57%). It also significantly inhibited the haemolysis of RBCs in both hypotonic solution and heat-induced conditions. This showed that it has moderate thrombolytic activity.

#### Antimicrobial Activity

The flavonoids isolated from the bark of *T. arjuna* were analysed to possess antimicrobial activity. Both bound and free flavonoids showed activity against all the pathogens. The maximum inhibitory effect was observed against *Agrobacterium tumefaciens* and *Bacillus subtilis* by both the flavonoids [21].

Reported studies showed the antimicrobial potential of *T. arjuna* leaves and bark extracts against various pathogens like *Staphylococcus aureus*, *Acinetobacter* sp., *Proteus mirabilis*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans*, pathogens causing ear infections [22]. Organic extract of *T. arjuna* bark showed a greater inhibition zone than the herbal drops for the treatment of bacterial ear infection especially *S. aureus*.

#### Anti-inflammatory Activity

The extracts were analysed for gross phytoconstituents level and their antioxidant activity was assayed by DPPH free radical scavenging activity and inhibition of lipid peroxidation. Singh et al., studied the anti-inflammatory activity of leaves of *T. arjuna* in the Wistar albino rat models. Results showed that the methanol extract of the leaves of *T. arjuna* possessed significant anti-inflammatory activities in the tested models [23,24]

#### Anti-diabetic activity

A study was conducted for the antidiabetic activity of aqueous stem bark extract of *T. arjuna*. Antidiabetic bioassay was analysed through estimation of blood counts, total cellular (i.e., proteins) and free haemoglobin content in diabetic blood plasma and also determined its haemolytic activity in human whole blood. The results revealed that the aqueous stem bark of *T. arjuna* have antidiabetic activity and also enhances the granulocyte count and decrease in free haemoglobin content including total cellular

content in diabetic human whole blood and plasma samples [25].

## II. CONCLUSION –

The present study reveals that Terminalia Arjuna is a very important medicinal plant with large number of phytochemical and pharmacological properties. From the above study we can conclude that Terminalia Arjuna is very potent drug which is used from ancient times to treat the various cardiovascular disorders. It contains many beneficial phytoconstituents such as tannins, flavonoids, saponins which provide the effective actions against heart related disorders such as angiogenesis, thrombosis, hypertension, myocardial infraction etc. It is also very useful in anti-bacterial, anti-viral, anti-mutagenic, anti-inflammatory, and wound healing activities, anti-dysenteric, anti-pyretic, anti-diabetic, anti-oxidant, gastric and reproductive activity.

This review gives an important view mainly on taxonomy of T. Arjuna, botanical description of arjuna, different phytochemical, physicochemical analysis and therapeutic uses and various clinical studies on the T, arjuna plant.

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