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TERMINALIA ARJUNA - A REVIEW

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ABSTRACT

The conventional device of medication comprise Terminalia Arjuna is moderate tree used in various ailment to cure it is *discovered* to verify diverse compound present in *them. Terminalia* Arjuna has been implemented to stability the three humors Kapha, Pitta, Vata. Terminalia Arjunais mankind of broadly used natural medicinal plant through the Bangladesh and used in traditionalsystem of medicine like Ayurveda, Siddha and Unani. Analytical active Constituent containing Gallic acid and Arjunolic acid, B-sitosterol, Terminic acid pyrocatechols, Calcium Magnesium Zinc copper it's been medicinal cost on Pharmacological dealers as Anticancer, Antimicrobial, Antiacne, Antidiabetic, AntianthelminticAnticholinesterase, *Anti-inflammatory*, Antioxidant, Antiasthmatic in addition to Wound recovery. Cardioprotective and insecticidal activities it's alsorelevant for the treating of most cancers, Cardiomyopathy and high blood pressure.

KEYWORD: Terminalia Arjuna, Gallic acid, Arjunolic acid, Antidiabetic, Cardiotonic, B-sitosterol, Terminic acid. Chemical constituents, medicinal properties, cardiovascular, CAD, angina pectoris, CHF, tannins, flavonoids, triterpenoids arjunolic acid.

INTRODUCTION

Medicinal flora plays a crucial position in health care and are the most important uncooked materials for both conventional and conventional medicine arrangements; nevertheless, the general public pick natural drugs than conventional drugs. Despite the fact that various restorative plants have been made sense of in the Indian standard helpful framework for therapy of a few illnesses, not very many plant items are these days used in the cutting-edge clinical framework to treat the majority of the sicknesses, especially; cardiovascular

sicknesses (CVD), ulcers, diabetes, hack, unnecessary sweat, asthma, growth, irritation and skin issues. Among the plants, one of the restorative plants natives to India is Terminalia arjuna (Roxb.) Wight and Arn., (T. arjuna) generally known as 'Arjuna', which has been utilized as a cardiotonic in cardiovascular breakdown, ischemic, cardiomyopathy, atherosclerosis, myocardium corruption and has been utilized for the treatment of various human illnesses like blood sicknesses, pallor, venereal and viral infection; and to proceed withphenomenal strength. Terminalia arjuna is a local Bangladeshi tree with straightforward leaf, smooth and thick bark having a place with the family Combretaceae. Blossoms are little, standard, sessile, cup-molded, polygamous, white, rich or greenish-white and powerfully honey-scented and blooming from April to July. The inflorescences are short axillary spikes or little terminal panicles and natural products are obovoid-elliptical, dim brown to ruddy brown sinewy woody, indehiscent drupe and maturing from February to May. Every one of the piecesof the plant have been utilized for their remedial recipient impact from antiquated times. T. arjuna assists with keeping a solid heart and reduction the impacts of pressure and tension. It has antibacterial antimutagenic, hypolipidemic, cell reinforcement and hypocholesterolaemic and mitigating impacts. The point of the current review was to convey the exacting investigations of T. arjuna with its phytochemical and pharmacological characteristics. The plant realm is a treasury of likely medications and over the most recent couple of a long time there has been a dramatic development in the field of home-grown medication. It is getting promote in creating and created nations attributable to its normal beginning and lesser side effects. The plant Terminalia arjuna Roxb. Regularly known as Arjuna, a typical tree for its significant phyto constituents has a place with the family combretaceae. It has been filled in many pieces of India and utilized in Ayurvedic definitions since antiquated times. The plant parts, for example, stem bark, leaves and products of T. arjuna are utilized in native arrangement of medication for various diseases. The bark powder has been found to have cardioprotective properties, hostile to ischemic, cell reinforcement activity, hypercholesterolemia effect, fungicidal and antibacterial, antimicrobial, Anti-inflammatory, immunomodulatory and antinociceptive activity, It is also useful to cure obesity, hypertensionand hyperglycemia. The higher cancer prevention agent capability of T. arjuna stem bark is because of the presence of higher measure of phenolic and flavonoids. The T. arjuna based phytochemicals are thought of as one of the most outstanding heart tonic, therefore, it tends tobe involved on day to day bases as tonic for solid cardiovascular system. Leaf has been accounted for hostile to malignant growth movement, antihyperglycemic activity, analgesic and anti-inflammatory.

Medicinal plants play an essential role in health care and are the major raw materials for both traditional and conventional medicine preparations; still, most of the people choose herbal medicines than conventional medicines. They expanded attention due to their effectiveness, lack of current medical alternatives, increasing cost of modern medicines and cultural preferences, Ethnobotanical studies are most important to expose the ancient times and current culture about plants in the world and reserving original knowledge of medicinal plants. The quantitative ethnobotanical studies were used to identify the plant uses as food, human health care medicines, veterinary medicine and economically important.

Around the world, the traditional knowledge system has expanded chief importance in perspective with protection, sustainable growth and search for new utilization patterns of plant resources. Traditional medicine system includes the knowledge, skills and practices based on the presumptions, beliefs and experiences of folk communities to protect their health problems. Traditional herbal medicines are considered to be of huge importance among different rural or native communities in many developing countries. According to WHO, almost 80% of the world's population depending on traditional medicine and in India 60% of the people in rural areas use herbal medicines. During the last few years, use of herbal supplements increased from 2.5% to 12%. In recent years, there has also been an increasing demand for nanoparticles derived from medicinal plants like Terminalia family due to their applications in various fields of research like medicine, catalysis, energy and materials. In the earliest India, medicinal plants were used to prevent different critical diseases and they would be the best source to obtain a variety of drugs. The Indian traditional medicine is based on various systems such as Ayurveda, Siddha, Unanai, etc. In recent years there has been an increasing awareness about the importance of medicinal plants. Herbal drugs are easily accessible, secure, less pricey, efficient and have very rare side effects. The evaluation of new drugs, especially the phytochemical obtained materials has opened a vast area for research and helpful in making a transition from traditional to modern medicine in India. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids, flavonoids, and phenols.

Even though numerous medicinal plants have been explained in the Indian customary therapeutic system for treatment of several diseases, very few plant products are nowadays utilized in the modern medical system to treat most of the diseases, particularly;

cardiovasculardiseases (CVD), ulcers, diabetes, cough, excessive perspiration, asthma, tumor, inflammation and skin disorders. Among the plants, one of the medicinal plants indigenous to India is Terminalia arjuna (Roxb.) Wight and Arn., (T. arjuna) commonly known as 'Arjuna', which has been used as a cardiotonic in heart failure, ischemic, cardiomyopathy, atherosclerosis, myocardium necrosis and has been used for the treatment of different human diseases like blood diseases, anemia, venereal and viral disease; and to continue excellent healthiness. It is used in the treatment of fractures, ulcers, hepatic and showed hypocholesterolemic, antibacterial, antimicrobial, antitumoral, antioxidant, antiallergic and antifeedant, antifertility and anti-HIV activities. T. arjuna is reported that to possess strong hydrolipidemic properties. It is trusted that the saponin glycosides in T. arjuna may be responsible for its inotropic effects, while the flavonoids/phenolics may supply antioxidant activity as well as vascular amplification activity, in this manner authenticating the multiple activities of this plant for its cardio-protective function. The aim of this review is to summarize the information and knowledge about the T. arjuna and updating available research data on the aspects of botany, ethnopharmacology, phytochemistry and clinical studies.

Terminalia arjuna, also commonly referred to as T. arjuna, is a deciduous tree that belongs to the family Combretaceae. It can be found in many regions of India. T. arjuna is a 60- to 80-foot-tall tree found alongside rivers and streams all over the Indo-sub-Himalayan areas of Delhi, Uttar Pradesh, Chota Nagpur, the southern part of Bihar, Madhya Pradesh and Deccan regions. It has been used to cure several ailments for as far back as the ancient times of India. It is most prevalently consumed to cure and manage several cardiac and vascular diseases, including those like CADs, Angina Pectoris, CHF/Hypertension, and Dyslipidaemia. Its extracts are used to improve cardiac muscles and thus effectively improve heart pumping, heart rate, and blood pressure. The many parts of the tree consist of several phytochemicals, including tannins, flavonoids, glycosides, and triterpenoids like Arjunolic acid, which contribute to its anti-oxidant anti-inflammatory antimicrobial, anticarcinogenic and antimutagenic properties. As of today, there have not been any reports of any harmful side effects regarding its administration. While there are various studies that support its use for a problem of diseases, further research is still required to understand its exact mechanisms. There is also a need for further research on T. arjuna regarding its drug interactions, its specific molecular mechanism of action, and the toxicology involved.

Terminalia arjuna (TA) is one such folklore medicinal herb, and it belongs to the Combretaceae family. The plant is mainly found in the Indian subcontinent. There are nearly 24 species in India, and it is a deciduous and evergreen tree that grows up to 20–30 m above the ground level. The different parts of the plant, such as the fruit, bark, leaf, seed, and root are found to possess different medicinal properties. Among them, barks are found to have rich medicinal value. It is one of the most commonly used plants in Siddha, Ayurveda, and Unani systems of treatment. In India, TA is recognized by different local names such as Arjuna/Arjun (Hindi), Marudhu (Tamil and Malayalam), Yella maddi (Telugu), Arjhan (Bengali), Sadaru (Marathi), Sadad (Gujarati), and Neer matti (Kannada). The phytochemicals extracted from TA (Figure 1) are found to have rich antioxidant properties in addition to several other bioactive properties, such as antioxidant, anti-inflammatory, cardio-protective, anti-atherosclerotic, and anti-tumor. TA exhibit various pharmaceutical properties when ischemia, cardiomyopathy, atherosclerosis, myocardium necrosis, tumor, viral diseases, ulcer and many others This review briefly explains the underlying mechanisms of the above-mentioned properties and their role in various pharmaceutical applications. In addition, this review also focuses on the various types of polymeric formulations to enhance the solubility, bioavailability, and stability of phytochemicals from TA extracts.

REVIEW OF LITERATURE

1. Augustine Amalraj, Sreeraj Gopi

Medicinal plants have been a main source of therapeutic agents from ancient time to cure diseases. Terminalia arjuna (Roxb.) Wight & Arn. (T. arjuna) is one of the most accepted and beneficial medicinal plants in indigenous system of medicine for the treatment of various critical diseases. This comprehensive review provides various aspects of its ethnomedical, phytochemical, pharmacognostical, pharmacological and clinical significance to different diseases particularly in cardiovascular conditions. This plant has a good safety outline when used in combination with other conventional drugs. This review highlights various medicinal properties of T. arjuna through different studies such as antioxidant, hypotensive, antiatherogenic, anti-inflammatory, anti-carcinogenic, anti-mutagenic and gastro-productive effect.

2. Gunjan M Chaudhari, Raghunath T Mahajan

Terminalia arjuna Roxb. (Family-Combretaceae) is commonly known as Arjun tree and valuedfor its medicinal uses. In the present investigation, the detailed pharmacognostic study of *T. arjuna* stem bark (TASB) is carried out to lay down the standards which could be useful in forthcoming experimental studies. The study includes microscopy, proximate analysis and physicochemical evaluation. Atomic absorption spectroscopic analysis of TASB revealed the presence of heavy metals within the recommended safety range. Qualitative phytochemical analysis of the methanolic extract of TASB (MeOH-TASB) confirmed the presence of alkaloids, glycosides, tannins, flavonoids, phenols, saponins and steroids in the extract. The UV-Vis and FTIR spectroscopic analysis of MeOH-TASB indicated the presence of aromatic phytoconstituents as predominant ingredient of the extract. The chemical fingerprinting of MeOH-TASB was performed by using TLC and GC-MS analysis which showed bands/peaks of different phytoconstituents. Findings of this study provide reference information on TASB for itsquality evaluation.

3. Dishant Desai, Sumitra Chandav

The aim of the present study was to carry out pharmacognostic and physicochemical analysis of *Terminalia arjuna* (TA) (Roxb.) Wight and Arn. (Family; *Combretaceae*) leaf. Materials and Methods: The present study deals with pharmacognostic characters as identification parametersof the leaves which were subjected to macro and microscopic studies. Phyto-physicochemical studies were done using WHO recommended parameters, and fluorescent behavior of the leaf sample was also tested. Results: The microscopy study revealed the presence of anomocytic stomata, trichome, xylem fibers, calcium oxalate crystals, vascular bundles, etc. Macroscopic study showed alternate thickcoriaceous base obtuse-subcordate while margin was crenate-serrate,obtuse or sub-acute at apex. Physiochemical parameters such as ash values, loss on drying, extractive values, fluorescence analysis were also determined. Preliminary phytochemical screening showed the presence of alkaloids, flavonoids, tannins, triterpenes, cardiac glycosides and saponins. **Conclusion:** The microscopic and physiochemical analysis of the *T. arjuna* leaf is useful in standardization for quality, purity, and sample identification.

4. Rajni HS, Manish RA

The traditional system of medicine contain Terminalia Arjuna is moderate tree used in various disease to cure It is identified to confirm various compound present in them. Terminalia

Arjunahas been applied to balance the three humors Kapha, Pitta, Vata. Terminalia Arjuna is mankindof widely used herbal medicinal plant through the Bangladesh and used in traditional system of Medicine like Ayurveda, Siddha and Unani. Analytical Active Constituent containing Gallic acidand Arjunolic acid, B-sitosterol, Terminic acid pyrocatechols, Calcium Magnesium Zinc copperit has been medicinal value on Pharmacological agents as Anticancer, Antimicrobial, Antiacne, Antidiabetic, Antianthelmintic Anticholinesterase,b Antiinflammentary, Antioxidant, Antiasthmatic as well as Wound healing. Cardioprotective and insecticidal activities it is also applicable for the treating of Cancer, Cardiomyopathy and Hypertension.

5. M. Halleys Khan, Hossain Md. Faruquee, Md. Munan Shaik

To cure human diseases, medicinal plants have been a major source of therapeutic agents since ancient time. Terminalia arjuna is one kind of widely used medicinal plant throughout Bangladesh and used in various indigenous system of medicine like Ayurveda, Sidda and Unani. This plant has been reported to contain active constituents including arjunolic acid, gallic acid, terminic acid, pyrocatechols, β-Sitosterol, calcium, magnesium, zinc, copper etc. which proved to be effective pharmacological agents as antimicrobial, anticancer, antidiabetic, antiacne, antihelmintic, antiinflammatory, anticholinesterase, antioxidant, antiasthmatic as well as wound healing, cardioprotective and insecticidal activities. It is considered to be an ideal agent for treating cancer, coronary artery disease, hypertension and ischemic cardiomyopathy. The present comprehensive update review is therefore an effort to give detailed information on phytochemical and pharmacological studies of T.Arjuna.

SCIENTIFIC CLASSIFICATION

Kingdom – Plantae
Sub kingdom – Tracheobionta
Division – Magnoliophyta
Sub Division – Spermatophyta
Class – Magnoliopsida
Order – Myrtales
Family – Combretaceae
Genus - Terminalia
Species - Arjuna

HABITAT

It is world well known tree popular for restorative utilized. The bark Terminalia Arjuna has been utilized in India for over 3000 years. Principally has a heart cure, the first to involved this item heart condition inthis seventh century AD research on the Terminalia Arjuna has been happening beginning around 1930. Terminalia Arjuna also Amandier Indian, Amandier Tropical, Argun Badamier Arjuna axjuna.

MACROSCOPIC CHARACTER

TREE: It is moderate tree having thick bark.

LEAVES: Terminalia Arjuna contain simple and smooth leaf.

FRUITS: Fruits are obovoid - oblong dark brown fibrous woody indehiscent drupe.

INFLOURESENCE: Terminalia Arjuna the inflorescences are short axillaries spikes or small terminalpanicles.

FLOWER: Flower is small regular, sessile cup shaped polygamous, white creamy orgreenish white androbustly honey scented.

POWDER: The powder of Terminalia Arjuna containing yellowish white.

GALLERY

Arjuna Tree

Arjuna Leave

Arjuna Bark

ArjunaFruits(dried)

PHYTOCHEMISTRY

The significant constituents of T. arjuna in stem bark, root bark, natural products, leaves and seeds are all around described (Table 1). The fundamental phytochemical examination of existing mixtures in T. arjunawas completed by different standard conventions as referenced by Harbone54 in Table 2. As bark was viewed as the main constituent according to the restorative perspective, at first announced that the bark had 34% debris content comprising completely of unadulterated calcium carbonate. Watery concentrate of T. arjuna is accounted for to have 23% calcium salts and 16% tannins. Natural concentrates of T. arjuna bark were likewise pre-arranged utilizing the consecutive techniques with various natural solvents like hexane, benzene, chloroform, CH3)2CO, dichloromethane, ethyl acetic acid derivation, butanol, ethanol, methanol and ether, and so on, to extricate different phytochemical constituents.

Table No.1.

Compounds	Stem/ bark	Root	Activity of compounds	References
Triterpenoids	Arjunin, arjunic acid, arjunolic acid, arjungenin, terminic acid	Arjunic acid arjunolic acid oleanolic acid terminic acid	Antifungal, cardioprotective	e Zhou et al., 2011a; Dwivedi, 2007
Glycosides	Arjunetin, Arjunaphthanoloside, Arjunoside I, II and Terminoside-A	Arjunoside I- IV Glucopyranoside	Cardioprotective	Dwivedi, 2007
Sitosterol	Sitosterol	Sitosterol	Antimutagenic, antiinflammatory, antitussive	Zhou et al., 2011d and Dwivedi, 2007
Flavonoids	Arjunolone, Arjunone, Bicalein, Luteolin, Gallic acid, Ethyl gallate Kempferol, Proanthocyanidins, Quercetin, Pelorgonidin,		Antiallergic, antibacterial, cytotoxic, antiasthmatic, antifungal, antioxidant	Zhou et al., 2011b,c,d and Dwivedi, 2007
Tannins	Pyrocatechols, Casuarinin, Casurin, Punicallin, Punicalagin, Castalagin, Terchebulin, Terflavin C,		Astringent, wound healing and antimicrobial	Dwivedi, 2007
Trace elements	Calcium, Aluminium, Magnesium, Silica, Zinc, Copper		To fill up ion requirement	Dwivedi, 2007

PRECLINICAL STUDIES

Cardioprotective potential of T. arjuna stem bark on the molecular basis was evaluated by Kokkiripati et al, using cell cultures of human monocytic (THP-1) and human aortic endothelial cells (HAECs).bInhibitory effect of alcoholic (TAAE) and aqueous (TAWE) extracts of T. arjuna stem bark wasassessed on human 3-hydroxy- 3-methylglutaryl coenzyme A (HMG- CoA) reductase, lipoprotein lipase (LpL) and lipid peroxidation in rat (Wistar) liver and heart homogenates. TAAE and TAWE inhibited the lipid peroxidation and HMG-CoA reductase. Both the extracts attenuated H2O2 mediated ROS generationin THP-1 cells by promoting catalase (CAT), glutathione peroxidase (GPx) activities, and by transcripts inTHP-1 cells and HAECs, whereas the response to TAWE depended on the type of transcript and cell type. Both extracts decreased the levels of typical inflammatory marker proteins, viz. LPS induced tumornecrosisfactor (TNF)-a secreted by THP-1 cells and TNF-a induced cell surface adhesion molecules on HAECs, namely vascular cell adhesion molecule-1 (VCAM-1) and Eselectin. The marked effects on cultured humanmonocytic and aortic

endothelial cells (HAEC) provide the biochemical and molecular basis for the therapeutic potential of T. arjuna stem bark against cardiovascular diseases (CVD). Triterpenoids are essentially responsible for cardiovascular properties. Alcoholic and aqueous bark extracts of T. arjuna, arjunic acid, arjunetin and arjungenin were evaluated for their potential to inhibit CYP3A4, CYP2D6 and CYP2C9 enzymes in human liver microsomes by Varghese et al. They have demonstrated that fall in LVP(LV [dP/dt] max and LV [dP/dt] min), cardiac contractility index (LV [dP/dt] max/LVP), and a rise in LVend-diastolic pressure. Altered lipid profile, oxidative stress, and increased levels of endothelin 1 (ET-1), tumor necrosis factor-a (TNF-a), and interleukin 6 (IL-6) along with histological changes in heart and pancreas were observed in diabetic rats.

T. arjuna significantly attenuated cardiac dysfunction and myocardial injury in diabetic rats. It also reduced oxidative stress, ET-1, and inflammatory cytokine levels. Sinha et al has investigated the antioxidative properties of an ethanol extract of the bark of T. arjuna (TAEE) against sodium fluoride (NaF)-induced oxidative stress in the murine heart. NaF intoxication significantly altered all the indices related to the prooxidanteantioxidant status of the heart. In addition, the ferric reducing/antioxidant powerassay revealedthat TAEE enhanced the cardiac intracellular antioxidant activity. Finally, they concluded that TAEE protects murine hearts from NaFinduced oxidative stress, probably via its antioxidant properties. Parveen et al examined the protective effect of T. arjuna bark extract on left ventricular (LV) and baroreflexfunction in chronic heart failure and to elucidate the possible mechanistic clues in its cardioprotective action. Fifteen days after isoproterenol administration, rats exhibited cardiac dysfunction, hypertrophy, and LV remodeling along with reduced baroreflex sensitivity. Prophylactic and therapeutic treatment with T. arjuna improved cardiac functions and baroreflex sensitivity. It has also attenuated hypertrophy and fibrosis of the LV. T. arjuna exerts beneficial effect on LV functions, myocardial remodeling, and autonomic control in chronic heart failure possibly through maintaining endogenous antioxidant enzyme activities, inhibiting lipid peroxidation and cytokine levels. Diethyl ether, ethylacetate and ethanol extractions of T.arjuna exerted hypolipidemic and antioxidative effects at twodifferent dose levels of 175 and 350 mg/kg body weight in Poloxamer (PX)-407 induced hyperlipidemic albino Wistar rats. Theresults suggested that the ethanolic fraction of T. arjuna possesses the potent properties of beingan antioxidant and hypolipidemic than other fractions. Kumar et al evaluated the effects of T. arjuna bark extract on myocardial fibrosis and oxidative stress induced by chronic b- adrenoceptor stimulation. Because myocardial fibrosis and oxidative

stress accompany a number of cardiac disorders such as hypertrophic cardiomyopathy, hypertensive heart disease and cardiac failure. Aqueous extract of T. arjunabark was evaluatedat 63, 125 and 250 mg/kg given orally for antifibroticand antioxidant effects in rats given the selective b-adrenoceptor agonist isoprenaline for 28 days. The T. arjuna bark extract significantly prevented the isoprenalineinduced increase in oxidative stress and declinein endogenous antioxidant level and also prevented fibrosis. Gauthaman et al studied that oral administration of T. arjuna for 12 weeks in rabbits caused augmentation of myocardial antioxidants; superoxide dismutase(SOD), catalase (CAT) andglutathione (GSH) along with induction of heat shock protein72 (HSP72). In vivo ischemic-reperfusion injury induced oxidative stress, tissue injury of heartandhemodynamic effects were prevented in the T. arjunatreated rabbit hearts. Alcoholic extract of T. arjuna bark and its extracts were evaluated for DNA protection, protein oxidation and free radicalscavenging activity. Ethanolic extract of T.arjuna bark (TAA) and its fractions, includingdichloromethane (TAD), ethyl acetate (TAE), butanol (TAB) and water (TAW)has significantantioxidant activity and potential to prevent protein oxidation, DNA damage protection by pBR322 DNAand SCGE assay. The potent antioxidative activity and DNA protection ability of T.arjuna bark extracts might be endorsed with phenolic/flavonoid compounds. A significant correlation was also observed between freeradical scavenging activity, in vitro DNA damage activity and the total phenolic/flavonoid content. Physicochemical property and inotropic effect of the aqueous extract of T. arjuna bark(TAAqE) were investigated by Oberoi et al on adult rat ventricular myocytes in comparison with extracts preparedsequentially with organic extracts. They found that TAAqE decoctions exerted positive inotropy, accelerated myocyte relaxation and increased caffeine-induced contraction concentrationdependently. TAAqE-induced cardiotonic action via enhancing SR function, a unique action minimizing the occurrence of arrhythmias, makes TAAqE a promising and relatively safe cardiotonic beneficial to the healthy heart and the treatment for chronic heart disease. Mandal et al investigated antioxidative and antimicrobial properties of methanolic extract of T. arjuna bark. The antimicrobial activity showed that higher inhibition against Gram negative bacteria than gram positive bacteria and showed a promising antioxidantactivity, as absorption of DPPH radicals decreased in DPPH free radical scavenging assay. Methanol extract from bark of T. arjuna exhibited medicinal as well as physiological activities. Methanol, ethanol, acetone, aqueous both hot and cold extracts from the leaves and bark of T. arjuna were tested for their antimicrobial activity against Staphylococcus aureus, Acinetobacter sp., Proteus mirabilis, Escherichia coli, Pseudomonas aeruginosa and Candida albicans, pathogens causing ear

infections. Three organic solvents evaluated, acetonic leaf extract was found to be best against S. aureus. Organic bark extract showed almost equal inhibition of all tested Gram negative bacteria except P. aeruginosa. Aqueous extract of T. arjuna bark exhibited good activity against S. aureus. Devi et al81 evaluated the effect of methanolic extract of T. arjuna (100 mg/kg to 50 mg/kg body weight) on diclofenac sodium (80 mg/kg bodyweight in water, orally) induced gastric ulcer in rats. The gastroprotective effect of T. arjuna was assessedfrom volume of gastric juice, pH, free and total acidity, pepsin concentration, acid output in gastric juice, the levels of non-protein sulfhydryls (NP-SH), lipid peroxide (LPO), reduced glutathione (GSH), and activities of enzymic antioxidants-super oxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-Stransferase (GST) and myeloperoxidase (MPO) in gastric mucosa. The levels of DNA, protein bound carbohydrate complexes- hexose, hexosamine, sialic acid, fucose in gastric mucosa and gastric juice and the levels of RNA in gastric mucosa were assessed. The stomach tissues were used for adherent mucus content and also for the histological examination. A significant reduction in lesion indexwas observed in ulcer induced animals treated with T. arjuna (DIC þ TA) compared to ulcerated rats (DIC). A significant increase was observed at pH, NP-SH, GSH, enzymic antioxidants, protein bound carbohydrate complexes, adherent mucus content, nucleic acids with a significant decrease in volume of gastric juice, free and total acidity, pepsin concentration, acidoutput, LPO levels and MPO activities in DIC þ TA rats compared to DIC rats. It is proved that T. arjuna could act as a gastroprotective agent probably due to its free radical scavenging activity.

CLINICAL STUDIES

Recently, Kapoor et al investigated the therapeutic potential of T. arjuna on the inflammatory markers in subjects with stable coronary artery disease (CAD). In a placebo-controlled, randomized double-blind study, 116 patients with stable CAD who were on standard cardiac medications for more than three monthswere enrolled and received either placebo or 500 mg of T. arjuna from Himalayan Herbal Healthcare, Bangalore, India twice a day in addition to receiving the conventional treatment. A significant decrease in serum triglycerides as well as in various inflammatory cytokines such as hsCRP, IL-18 ($P < 0.001$), IL-6 and TNF-a ($P < 0.05$) was observed at 3 months in patients who were on drug treatment as compared to the placebo. The effects were maintained till 6 months follow-up and showed a further reduction in hyperlipidemia and inflammatory markers with time. An observational study was conductedto find out theeffects of T. arjuna in patients with dilated cardiomyopathy (DCMP) of

idiopathic and ischemic cause. Ninety three patients with DCMP receiving standard therapy and/ or bark extract of T. arjuna 500 mg 8 hourlywere enrolled. Three groups as standard therapy(ST, Group 1), T. arjuna therapy (TA, Group 2) andstandard therapy with T. arjuna (ST þ TA, Group 3) were formed. At the end of the study period, patients of group 3 showed significant improvement in percentage of left ventricularejection fraction (LVEF%) (7 ± 1.6, $P < 0.00001$) compared to group 1 and 2 ($P < 0.00001$, $P < 0.0001$). Reductions in Left ventricular end systolic and diastolic diameters and volumes were most significant in group 3 (8.3 ± 4.7, $P < 0.0001$ and 3.1 ± 5.7, $P < 0.001$) and (11 ± 26, 9 ± 21 $P < 0.01$) respectively in comparison to other groups. Pulmonary artery pressure reduced significantly in group 1 and 3 ($P < 0.0001$). A similar reduction in diastolic score and mitral regurgitation ($P < 0.01$ and $P < 0.0001$) was observed in groups 1 and 3. From the results, dilated cardiomyopathy with reduced LVEF due to either idiopathic or ischemic cause receivingstandard therapy with T. arjuna showed significant improvement inleft ventricular parameters as well as functional capacity. Bharani et al investigated the salutary effect of T. arjuna in patients with severe refractory heart failure. Twelve patients with refractory chronic congestive heart failure (Class IV NYHA), related to idiopathic dilated cardiomyopathy (10 patients); previous myocardial infarction (one patient) andperipartumcardiomyopathy (one patient), received T. arjuna, as bark extract (500 mg 8 hourly) or matchingplacebo for 2 weeks each, separated by 2 week washout period, in a double blind crossover design as an adjuvant to maximally tolerable conventional therapy (Phase I). On long term evaluation in an open design(Phase II), wherein Phase I participants continued T. arjuna in fixed dosage (500 mg 8-hourly) in addition to flexible diuretic, vasodilator and digitalis dosage for 20e28 months (mean 24 months) on outpatient basis,patientsshowed continued improvement in symptoms, signs, effort tolerance and NYHA Class, with improvement in quality of life. Dwivedi et al were conducted a study to evaluate the role of T. arjuna in ischemic mitral regurgitation (IMR) following acute myocardial infarction (AMI). 40 patients with fresh AMI showing IMR were randomly divided into 2 groups of 20 each. Two groups were observed between one and three months therapy with T. arjuna at a dose of 500 mg twice a day and showed significant decreases in IMR, improvement in E/A ratio and considerable reduction in angina frequency. Bharani et al conducted astudy on the efficacy of T. arjuna in chronic stable angina. Fifty eight males with chronic stable angina (NYHA class IIeIII) with evidence of provocable ischemia on treadmill exercise test receivedTA (500 mg 8 hourly), isosorbide (40 mg/daily) or a matching placebo for oneweek each, separated by awashoutperiod of at least three days in a randomized, double-blind, crossover design. They underwent clinical,biochemical and treadmill exercise

evaluation at the end of each therapy, which were compared duringthe three therapy periods. T. arjuna therapy was associated with asignificant decrease in the frequency of angina and the need for isosorbide dinitrate. T. arjuna bark extract, 500mg 8 hourly, given to patients withstable angina with provocable ischemia on treadmill exercise, led to improvement in clinical and treadmillexerciseparameters as comparedto placebo therapy. These benefits were similar to those observed withisosorbide mononitrate (40 mg/day) therapy and the extract was well tolerated. The effectof an Ayurvedic formulationof T. arjuna, known as 'Arjuna Kwatha' was assessed by Rao et al in 36 hypertensive patientsat stage III with increased LV mass. The patients were divided into two groups, one group received atenolol (50 mg twice daily) and the other group 'Arjuna Kwatha' (25ml twicedaily) along with atenolol for 6 months. A significant decrease was observed in both SBP andDBP (P< 0.001)in both the groups. However, LV mass index was only significantly reduced in the atenolol-plus-'Arjuna Kwatha' group as compared to atenolol alone (P < 0.001), due to negative chronotropic and inotropiceffects of the herbal preparation. Khalil reported that the administration of T. arjuna bark powder alongwith statins for 3months to 30 patientswith coronary artery disease resulted in a 16% in LDL-cholesterol, 15% decrease in total cholesterol and 11% in triglycerides, confirming its immense potential to correct dyslipidemia in conjunction with statins. Gupta et al evaluated the antioxidant and hypocholesterolaemic effects of T. arjuna tree bark and to compare it with a known antioxidant, vitamin E, also performed arandomized controlled trial. One hundred and five successive patients with coronary heart disease (CHD) were recruited and divided into 3 groups of 35 each in this study. Group I received placebo capsules; Group II vitamin E capsules 400 units/day; and Group III received finely pulverized T. arjuna tree bark- powder (500 mg) in capsules daily. Lipids and lipid peroxide levels were determined at 30 days follow-up. No significant changes in total, HDL, LDL cholesterol and triglycerides levels wereseen in Groups Iand II. In Group III, there was a significant decrease in total cholesterol (_9.7 ± 12.7%),and LDLcholesterol (_15.8 ± 25.6%) (paired t-test P < 0.01). Lipid peroxide levels decreased significantly in boththe treatment groups (P < 0.01). This decrease was morein vitamin E group (_36.4 ± 17.7%) as comparedto the T. arjuna group (_29.3 ± 18.9%). T. arjunatree bark powder has significant antioxidant action that is comparable to vitamin E andalso hasa significant hypocholesterolaemic effect. A study was conductedby Bharani et al to determine the improvement of endothelial dysfunction in smokers. Eighteen healthy male smokers (age 28.16 ± 9.45 years) and an equal number of age-matched, non-smoker controls participated inthe study. The smokers were given T. arjuna (500 mg, 8 h) or matching placeborandomly in a double blind crossover design for two weeks each, followed

by repetition of brachial artery reactivity studies to determine various parameters including flow-mediated dilation after each period. The flow- mediated dilation showed significant improvement from baseline values after T. arjuna therapy.

MEDICINAL USE

Antimicrobial activity: scientifically analysis reported that water extract of Terminalia Arjuna barks shows maximum amount of antimicrobial antimicrobial activities against Proteus Vulgaris, Klebsiella aerogenes, Eschrichia coli and Pseudomonas aerogenis. The presence of antibacterial activity in the bark ofTerminalia Arjuna exhibiting selectively maximum activity against S. epidermidis.

Anticancer activity: Revealing that the different sort of malignant growth to treat Terminalia Arjuna separates are accumulated. Natural concentrates of Terminalia Arjuna shows to improve expanded level of life. Arjuna separate actuating DNA harm in HepG2 cells demonstrated that Terminalia Arjuna removeprompts ROS creation in HepG2 cells and thuslycauses apoptosis.

Antifungal activity: Terminalia species found five contain of natural concentrates like (T. arjuna, T. chebula, T. bellerica, T. catappa and T. alata) were tried with plant pathogenic organisms for example A. flavus, A. alternata, A. niger, A. brassicicola, and H. tetramera. The current concentrate of five plant leavesshows restrains the plant microbes. The bark extricates were more helpful than fungicide gainful in this antifungal test. Extreme emphatically antifungal action against C. parapsilosis, C. krusei and C. albicans was exist by a combination of arjunolic corrosive with least inhibitory focus (MIC) values in the scope of 50-200 µg/ml.

Antidiabetic activity: The Terminalia Arjuna removes have capacity to activity on diabetic. In the deductively examination diabetic rodents model treated with Terminalia Arjuna separates showed two chemicals (glucose-6-phosphatase, fructose-1, 6-diphosphatase) much decreased in liver and kidney. They have a capacity to increment insulin discharge which can respond on suppression of the gluconeogenic key catalysts (glucokinase and phosphofructokinase). Terminalia arjun bark separate uncovered antidiabetic movement by esteem the furthest use of glucose which can kidney glycolysis and fixing the weakened liver and by diminishing its gluconeogenic age as like as insulin. The tannin, saponin, flavonoids andother constituent's presence in the bark this activity might be because of capacity of its

ingrednts, which could act important constitution in upgrading the impact of glycolytic and gluconeogenic compounds. have research the prophylactic medium of arjunolic acid against streptozotocin (STZ) treat diabetes in the pancreatic tissue of Swiss albino rats. STZ administration (at a dose of 65mg/kg body wt, injected into thetail vein) causes an increase in the production of both ROSand reactive nitrogen species (RNS) in the pancreas of labortical animals. Formations of these reactive intermediates minimize the intracellular antioxidant defense, maximize the levels of lipid peroxidation, protein carbonylation, serum glucose and TNF-α.

Antiacne Activity: Skin arrangement made cream of Terminalia Arjuna separate containing flavonoid (FF- I to III) and tannin division (TF-I to III) have been created, which were examination antimicrobial movement against Propionibacterium acnes and Staphylococcus epidermidis. The creation of FF-III(creamcontaining 2% flavonoid division) has present most extreme antibacterial movement against P. acnes (zones of hindrance >17 mm) and S. epidermidis (zones of hindrance >20 mm) than other creation and which is like that of standardpromoted effective natural readiness. Natural enemy of skin break out cream is non-poisonous, safe, and viable and treat patient consistence by the utilization of home grown separates from Terminalia Arjuna would be profoundly adoptable.

Anthelmintic activity: Bark rough methanolic concentrates of Terminalia Arjuna arrangement anthelmintic action both in vitro (eggs, hatchlings and grown-up of Haemonchus contortus and in vivo research against blended gastrointestinal trichostrongylid nematodes of sheep. Terminalia Arjuna bark goes about as Anthelmintic action and might be fundamentally credited to its tannin content that ties with a free protein development in the cylinders for larval sustenance and lessening supplement movement bringing about larval diminished gastrointestinal digestion by straightly hindering the oxidative phosphorylation subsequently causing larval passing.

Wound healing activity: Terminalia Arjuna bark extricate contain hydroalcoholic, phytoconstituents wasaccounted for to be utilized in effective application on mending rodent dermal injuries. In rodent twisted made on back it have been treated with skin applied as straightforward salve. Results demonstrate that portion III arranged as 1% basic treatment respond total epithelialization on day 20, though division I respond total epithelialization on day 9, which vital comprises of tannins42. The capacity shows of Terminalia Arjuna to add

upto epithelisation of extraction wounds and greatest elasticity of entry point wounds.

Cardioprotective activity: Terminalia Arjuna has a capacity to utilize different helpful ways heart sickness that beginning on observational appearance kept in changed therapy of old medication.

Cardiotonic activities: In ayurvedic medication arjunolic corrosive is utilized as a heart tonicfor a really long time and it has been first distinguish from Terminalia Arjuna. The bark separates have wide part triterpenoid saponin is an arjunolic acid. Physico detailed carried on the trial bunny and frog heart uncovered that Terminalia Arjuna bark had cardiotonic. It was thusly revealed that intravenous organization of the glycoside, development from the bark of Terminalia Arjuna, brought about ascent in blood pressure. It was showed that the bark powderhas a cardiotonic property and diuretic. The scientific answered to detached frog heart uncovered that the water base concentrate of the bark had chronotropic andinotropic exercises.The watery concentrate of the bark is recognized from rodent atria that came about certain inotropic movement. Water base concentrate of the bark was distinguish from rodent atria that wasagain brought about ensuing work where created inotropic activity which was appearing bypropanolol and cocaine. The new component 16, 17-Dihydroneridienone, 3-O-*β*-D- glucopyranosyl-(1-6)- O-*β*-D- galactopyranoside is recognize from arjuna root and pertinent asa cardiotonic.

Coronary flow: analysis structure bark to infuse fluid concentrate into detached hare heart to greatest incoronarystream. The portion was 1024 µg/ml that causes most noteworthy expansion in coronary stream.

Hypotensive effects: The investigation of infusion of alcoholic and watery concentrate into intravertebraland intracerebro-ventricular concentrate of bark that was portion subordinate tenacious bradycardia and hypoten-sion. Albeit the alcoholic concentrate show the hypotensive impact in canines was acquire by pre-treatment with atropine. In one more manner tried in canines where intravenous prompt of wateryconcentrate of Terminalia Arjuna brought about portion junkie falls in blood pressure.

Effect on aortic prostaglandins: Those hares Aortic prostaglandin E2 like action was improved thatwere regulated Terminalia Arjuna contrasted with the individuals who were on fake treatment. The findingof raised PGE2 like action was critical on the grounds that PGE2

is known to deliver coronary vasodilation. This may conceivably show the pharmacological premise of the expanded coronary stream following Terminalia Arjuna infusion. This may likewise be partaking to the significant job of Terminalia Arjuna incoronary vein illness (CAD)patients.

Anti-inflammatory: To take two unrefined natural ethanolic concentrate of Datura stramonium (leaves) Terminalia arjuna (bark) and Withania somnifera (root) that break down polyherbal planning have calming capacity to oppose the chemical cycloxygenase (COX) prompting oppose of prostaglandinamalgamation causing aggravation at the third stage. From the examination of this review, it very well maybe achieved that polyherbal readiness came about critical mitigating and pain relieving activities.

Insecticidal property: In the stem Terminalia Arjuna disconnected from Arjunolic corrosive displays critical oppose action towards 4 th instar hatchlings of Spilarctia obliqua. More fixation to less measure oftaking care of and development of the hatchlings has been viewed as 666.9 and 617.8 ppm, individually (Bhakuni et al., 2002).

Antioxidant activity : In Terminalia Arjuna bark contain cell reinforcement movement test that showed critical cancer prevention agent exercises with the IC50 worth of 7.05 µg/ml. In light of Methanol concentrate of Terminalia Arjuna has extraordinary cancer prevention agentaction and may have capacityuse in medicine.

Antiasthmatic Activity: Terminalia Arjuna contain Arjunolic corrosive and alcoholic concentrate have huge pole cell adjustment action and arjunolic corrosive shows well preferable adjustment reactor over alcoholic concentrate of TA. The antiasthmatic and antianaphylactic action might be because of the polecell settling capacity and restraint of antigen initiated receptor and acetylcholine release.

Gastro protective effect: Terminalia Arjuna assume significant part as a gastroprotective specialist likely on the grounds that its cytoprotective nature and free extremist searching activity.

Decrease arsenic-induced toxicity: In presents Arjunolic corrosive assume significant part against arsenic-actuated cell oxidative uncover (Mannaetal., 2007).

CONLUSION

The present dissect research which uncover its references that Terminalia Arjuna is extremely advantageous plant. The enormous number of phytochemical and pharmacological properties additionally restoratively and synthetic substances significant. The most astonishing parts of the plant were conclusionof heart infections, diabetics and malignant growth. It's accounted for parts wide reach as favor of humanity to fix sickness like antimutagenic, mitigating, antibacterial, antiviral, and wound recuperating exercises. Accordingly, this exploration can audit be made for human valuable hotspot for the specialists to do orderlyinformation on homegrown and poly-natural medications from Terminalia Arjuna.

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