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Phytochemistry Pharmacology and Botanical Aspects of Terminalia Arjuna

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ABSTRACT
Medicinal shops have been a main source of remedial agents from ancient time To cure conditions. Terminalia arjuna(Roxb.) Wight & Arn.(T. arjuna) is one ofThe most accepted and salutary medicinal shops in indigenous system of drug for The treatment of colorful critical conditions. This comprehensive review provides Colorful aspects of its ethnomedical, phytochemical, pharmacognostical, Pharmacological and clinical significance to different conditions particularly in Cardiovascular conditions. This factory has a good safety Figure when used in Combination with other conventional medicines. This review highlights colorful Medicinal parcels ofT. Arjuna through different studies similar as antioxidant, Hypotensive,antiatherogenic,anti-inflammatory,anti-carcinogenic,anti-mutagenic And gastro-productive effect. Brand © 2016, Center for Food and Biomolecules, National Taiwan University. Product and hosting by Elsevier Taiwan LLC. This Is an open access composition under the CC in- NC- ND license.

KEYWORDS : Terminalia arjuna Medicinal property Phytochemistry Coronary Artery disease Triterpenoids

I. INTRODUCTION

Medicinal shops play an essential part health care and are the materials the Accoutrements for both traditional and conventional drug medications; still Utmost of the people choose herbal drugs than conventional drugs.[1] They Expanded attention due to their effectiveness, lack of the current effectiveness, Lack of current medical druthers , adding cost of the Modern ultramodern drugs And artistic preferences.[2, 3]Ethnobotanical studies are most most important to Expose the ancient times and current culture about shops in the world and Reserving original knowledge of medicinal shops. The quantitative ethnobotanical Studies were used to identify the factory uses as food [4] mortal health care Drugs,[5] veterinary medicine[6] and economically important.7Around the World, the traditional knowledge system has expanded principal significance in Perspective with protection, sustainable growth and hunt for new application Patterns of factory Coffers. Traditional drug system includes the knowledge, Chops and practices grounded on the presuppositions, beliefs and gests of folk Communities to cover their health problems.Traditional herbal drugs are Considered to be of huge significance among different pastoral or native Communities in numerous the developing countries.[8]According to WHO, Nearly 80 of the world supopulation depending on traditional drug and in India60 Of the people in pastoral areas use herbal drugs.[1]During the last many times, Use ofherbal supplements increased from2.5 toIn recent times, there has also been An adding demand fornano particles deduced from medicinal shops like Terminalia family due to their operations in colorful fields of exploration like Drug,catalysis, energy and accoutrements .[10] e12Inthe foremost India, Medicinal shops were used to help different critical Conditions and they would Be the stylish source to gain a variety of medicines. The Indian traditional drug Is groundedon colorful systems similar as Ayurveda, Siddha, Unanai, etc. Recent times there has been an adding mindfulness about the significance of Medicinal shops. Herbal medicines are fluently accessible, secure, less precious, Effective and have veritably rare side goods. The evaluation of new medicines, Especially the phytochemical attained accoutrements has opened a vast area for Exploration and helpful in making a

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transition form traditional to the ultramodern Drug in India. Medicinal plantscontain someorganic composites which give Definite physiological action on the mortal body and these bioactive substances Include tannins, alkaloids, carbohydrates, terpenoids, steroids, and flavonoids, And phenols.[13] indeed though multitudinous medicinal shops have been Explained in the Indian customary remedial system for treatment of the several Conditions, veritably many factory products are currently employed in the Ultramodern medical system to treat utmost of the condition particularly; Cardiovascular conditions(CVD), ulcers, diabetes,cough, inordinate perspiration, Asthma, excrescence, inflammation and skin diseases. Among the shops, one of The medicinal shops indigenous to India is Terminalia arjuna(Roxb.) Wight ,Arn.,(T. arjuna) generally known as ' Arjuna ', which has been used as Cardiotonic in heart failure, ischemic, a the cardiomyopathy, atherosclerosis, and Myocardium necrosis and has been used for the treatment of different mortal Conditions like blood conditions, and anemia, ,venereal and viral complaint; andTo continue excellent wholesomeness. It's used in the treatment of fractures, Ulcers, hepatic and showed hypo cholesterolemic, antibacterial, and Antimicrobial, antitumoral, antioxidant antiallergic and antifeedant, antifertility And antiHIV conditioning.[14]. Arjuna is reported that to retain strong hydro Lipidemic parcels.[16] It's trusted that the saponin glycosides in T. arjuna may be Responsible for its inotropic goods,while the flavonoids phenolics.may supply Antioxidant exertion as well as vascular modification exertion, in this manner Authenticating the multiple conditioning of this factory for its cardio-defensive Function.[17] . The end of this review is to epitomize the information and Knowledge about the T. [19]

II. METHODS

Systematic literature searches were carried out and the available information on Various plants traditionally used for cardiovascular disorders was collected via Electronic search and a library search for articles published in the peer reviewed Journals and also locally available books.

OCCURRENCES BOTANICAL DESCRITION AND ETHNOPHARMACOLOGY

Arjuna is an ayurvedic factory with important medicinal value. It is generally Known as Arjuna, Indradru, Partha and Veeravriksha[20] which is belongs to Combretaceae family comprising of nearly 200 species distributed around the World. Nearly 24 species of Terminalia have been reported from colorful corridor Of India, some named species are T. arjuna, Terminalia bellirica, Terminalia Bialata, Terminalia catappa, Terminalia elliptica, Terminalia porphyrocarpa, Terminalia mantaly etc. In India,T. arjuna is about 60 to 80 bases in height,Buttressed box and horizontally spreading crown and drooping branches Distributed in India, Burma, Mauritius and Sri Lanka.[19,,22] T. arjuna is Distributed throughout sub Indo-Himalayan tracts of Uttar Pradesh, Punjab, Deccan, South Bihar, Orissa, West Bengal and Madhya Pradesh substantially Along seaside, streamlets and ponds. It is known by its colorful conversational Names, the most generally used bones are Arjuna(Common Name), Arjun(Hindi), Marudhu(Tamil and Malayalam), Tella Maddi(Telugu), Arjhan(Bengali), Sadaru (Marathi), Sadado(Gujarati), Neer matti(Kannada) and some Traditional phrasings define in the name of Arjun arishta and Arjuna ghrita.Leaves Of T. arjuna are simple, frequently crenulations, borne subopposite, shortly acute Or blunt at the apex, coriaceous and oblong or elliptic. Their upper face is pale or Dark green and the lower face is pale brown. The tree bears white sessile bisexualFlowers in short supplementary harpoons or in a terminal panicle arrangement. Fruits of T. arjuna are drupe, elliptical , stringy- woody and smooth- barked with Five hard bodies or angles which are oblique and twisted overhead. Stem dinghy Is simple, smooth and pinkish-argentine in color in external view. An internal View, the dinghy is soft and sanguine in color.[23]

PHYTOCHEMISTRY

The major ingredients of T. arjuna in stem dinghy, root dinghy, fruits, leaves and Seeds are well characterized(Table 1). The primary phytochemical analysis of Being composites in arjuna was carried out according to colorful standard Protocols as mentioned by Harbone[54]. As dinghy was considered to be the most Important element from the medicinal point of view, originally reported that the Dinghy had 34 ash content conforming entirely of pure calcium carbonate. Waterless excerpt of T. arjuna is reported to have 23 calcium mariners and 16 Tannins. Organic excerpts of T. arjuna dinghy were also prepared using the Successional styles with a number of organic detergents similar as hexane, Benzene, chloroform, acetone, dichloromethane, ethyl acetate, butanol, ethanol, Methanol and ether,etc., to prize colorful phytochemical ingredients. The Chemical structures of available Composites were verified by colorful advanced Ways like HPLC, UPLC, LC- ESI- MS/

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MS analysis.26, Polyphenols, flavonoids, Tannins, triterpenoids, saponins, sterols and minerals are the major ingredients ofT. arjuna. Similar amino acids like tryptophan, tyrosine, histidine and cysteine are Also the main constituents in T. arjuna.

Step 1. Terpenoids, Ursane Triterpenoids And Glycosides

At first an oleanane triterpenoid named, arjunin, and a lactone, arjunetin were Insulated from the benzene and ethanolic Excerpts of its dinghy independently Honda et al,[32]originally verified that the presence of arjunic acid and Arjungenin and subsequently reported that two further glucosides videlicet arjun Glucoside I and II in the stem dinghy of T. arjuna. Anjaneyulu and Prasad,49 Verified that the presence of arjunoside III and IV, terminic acid, and a triterpene Carboxylic acid by ethyl acetate birth of roots of T. arjuna Hexane birth of stem Of T. arjuna authenticated that the presence of terminic acid and b- sitosterol.28 Ali et al36 has insulated another oleanane type triterpane, terminoside A from the Acetone bit of the ethanolic excerpt of T. arjuna's stem dinghy. The structure of This new emulsion was established as olean—triol-12-en-28-oic acid- 3b- D-Glucopyranoside. It was displayed that terminoside A inhibits nitric oxide product And decreases inducible nitric oxide synthase situations in lipopolysaccharide Stimulate macrophages.[35, 36] Five ursane type triterpene glucosyl ester Including new one, 2a, 3b- dihydroyurs acid 28- O- b- Dglucopyranosyl ester, And four given ursane triterpene glycosyl esters videlicet, 2a, 3b, 23- Trihydroxyurs acid- O- b- D- glucopyranosyl ester, quadranosie VIII, Kajiichigoside and 2a, 3b, 23- trihydroxyurs- 12, 19- dien-28-oic acid 28- O- b- Dglucopyranosyl ester were insulated from dinghy ofT. Arjuna Fig. 2).30 3- O-b- D- glucopyranosyl- 2a, 3b, 19a- trihydroxyolean—en-28-oic acid, 28- O- b- D-glucopyranoside and 2a, 19a- dihydroxy-3- oxo-olean-12-en28-oic acid 28- O- b-D- gluco- pyranoside are insulated from dinghy of T. arjuna by Choubey and Srivastava50 and Upadhyay et al[51] through spectrochemical analysis. Patnaik Al38 using chromatography fashion insulated a triterpenoid glycoside from the Dinghy of T. arjuna and linked it's an (olean- 3b, 22b- diol-12-en-28 b- D-Glucopyranoside- oic acid. Alam et al39 were insulated two further glycosides Videlicet Termiarjunosidolean—tetraol-12-en-28-oicacid-3b- D-glucopyranoside) And Termiarjunoside II(Olean- 3a, 5a, 25- triol,28- dioicacid- 3b- D- Glucophyranoside) from the ethanolic excerptof TA dinghy. Arjunglucoside IV And V, ArjunasidesA-E were Insulated from the ethanolic excerpt of the stem Dinghy of T. arjuna by Wang etal. [30],

Step 2Flavonoids And Phenolics

Dinghy of T. arjuna contains a veritably high position of flavonoids, videlicet Arjunolone, flavones, luteolin, baicaleiin, quercetin, kempferol, and pelargonidin Estimated with other medicinal shops particularly having favorable Goods on Cardiovascular conditions. The emulsion luteolin has been insulated from the Butanolic bit of T. Arjuna and it has been set up to be antimutagenic and Antibacterial exertion. It inhibited gram negative pathogen growth with a minimal Inhibitory attention of12.5 mg/ slice. Waterless excerpt of T. arjuna contains 70 Polyphenols having a molecular weight lesser than3.5 kDa and they're verified by The HPLC and LCMS. The waterless excerpt contains flavon-3-ols, similar as(Þ)- catechin,(þ)- gallocatechin and()- epigallocatechin; gallic acid, ellagic acid And its derivations similar as 3- O- methyl ellagic acid 4- Ob- Dxylopyranoside And 3- O- methyl ellagic acid 3- O- rhamnosideColorful studies support the fact That bioflavonoids inhibit LDL oxidation, endothelial activation and platelet Aggregation.[59] Due to the presence of free revolutionary scavenging action of The colorful phenolic contents inT.[62] arjuna, it acts as stronganti-proliferative And anti-oxidant agent.[63] There's an equally relationship between the high input Of salutary flavonoids and the threat of coronary roadwaycomplaint(CAD), so Possible account for input of high flavonoids content TA is salutary goods in CAD.

Setp 3 Tannis

Tannins are known to enhance the conflation of nitric oxide and relax vascular Partspre-contracted with norepinephrine. In addition to a flavonoids variety of Tannins have been insulated from the dinghy of T. arjuna. Around fifteen types of Tannins and their affiliated composites were insulated from the dinghy of T. arjuna And their structures were illustrated with the help of spectral analysis.Hydrolyzable tannins are castalagin, casuariin, casuarinin, punicalagin, Pyrocatechols, punicallin, terchebulin and terflavin C were Insulated from the Dinghy ofT. Arjuna.Tannins are considered to have crack mending, tangy, Hypotensive, antioxidant and antimicrobial goods.[64, 65]

Setp 4 Minerals and amino acids

The bark of T. arjuna contains large amount of various minerals and trace Elements such as magnesium (4000 mg/g), calcium (3133 mg/g), zinc (119 mg/g) And copper (19 mg/g).[47] It contains

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some amino acids such as tryptophan, Tyrosine, histidine and cysteine.[26,27,57]

PHARMACOLOGICAL AMD CLINICAL STUDIES

Arjuna is a tree having an wide medicinal eventuality in most of the conditions Particularly cardiovascular diseases. Scientific examinations of T. arjuna Considerably reported and bandied through colorful preclinical and clinical Studies(Tables 3 and 4).

A.Pharmacological StudiesCardioprotective eventuality of T. arjuna stem dinghy on the molecular base wasEstimated by Kokkiripati et al, [56] using cell societies of mortal monocytic(THP- 1) and mortal aortic endothelial cells (HAECs). Inhibitory effect of Alcoholic(TAAE) and waterless(TAWE) excerpts of T. arjuna stem dinghy was Assessed on mortal 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 excerpts downgraded H2O2 intermediated ROS Generation in THP- 1 cells by promoting catalase(CAT), glutathione peroxidase(GPx) conditioning, and by sustaining cellular reducing power. TAAE was largely Effective in satisfying proin-flammatory gene reiterations in THP- 1 cells and HAECs, whereas the response to TAWE depended on the type of paraphrase and Cell type. Both excerpts dropped the situations of typical seditious marker Proteins,viz.LPS convinced excrescence necrosis factor(TNF)- a buried by THP-1 cells and TNF- a convinced cell face adhesion motes on HAECs, videlicet Vascular cell adhesion patch- 1(VCAM-1) and Eselectin. The pronounced goods On dressed mortal monocytic and aortic endothelial cells(HAEC) give the Biochemical and molecular base for the remedial eventuality ofT. Arjuna stem Dinghy against cardiovascular conditions(CVD). Triterpenoids are basically Responsible for cardiovascular parcels. Alcoholic and waterless dinghy excerpts Of T. arjuna, arjunic acid, arjunetin and arjungenin were estimated for their Eventuality to inhibit CYP3A4, CYP2D6 and CYP2C9 enzymes in mortal liver Microsomes by Varghese etal. [66]They've demonstrated thatParaphras fall in LVP(LV(dP/ dt) maximum and LV(dP/ dt) min), cardiac contractility indicator(LV(dP/ dt) maximum/ LVP), and a rise in LV end- diastolic pressure. Altered Lipid profile, oxidative stress, and increased situations of endothelin 1(ET-1), Excrescence 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 downgraded cardiac dysfunction and myocardial injury in diabetic Rats. It also reduced oxidative stress, ET- 1, and seditious cytokine situations.[72]Sinha et al[73] has delved the antioxidative parcels of an ethanol excerpt of the Dinghy ofT. Arjuna(TAEE) against sodium fluoride(NaF)- convinced oxidative Stress in the. Murine heart. NaF intoxication significantly altered all the indicators Affiliated to the prooxidanteantioxidant status of the heart. In addition, the ferric Reducing/ antioxidant power assay revealed that TAEE enhanced the cardiac Intracellular antioxidant exertion. Eventually, they concluded that TAEE protects Murine hearts from NaFinduced oxidative stress, presumably via its antioxidant Parcels. Parveen et al[74] examined the defensive effect of T. arjuna dinghy Excerpt on left ventricular(LV) and baroreflex function in habitual heart failure And to interpret the possible mechanistic suggestions in its cardioprotective Action. Fifteen days after isoproterenol administration, rats displayed cardiac Dysfunction, hypertrophy, and LV redoing along with reduced baroreflex Perceptivity. Precautionary and remedial treatment with T. arjuna bettered cardiac Functions and baroreflex perceptivity. It has also downgraded hypertrophy and Fibrosis of the LV.T. arjuna exerts salutary effect on LV functions, myocardial Redoing, and autonomic control in habitual heart failure conceivably through Maintaining endogenous antioxidant enzyme conditioning, inhibiting lipid Peroxidation and cytokine situations. Diethyl ether, ethyl acetate and ethanol lines Of T. arjuna wielded hypolipidemic and antioxidative goods at two different cure Situations of 175 and 350 mg/ kg body weight in Poloxamer(PX)-407 convinced Hyperlipidemic albino Wistar rats. The results suggested that the ethanolic bit of T. arjuna possesses the potent parcels of being an antioxidant and hypolipidemic Than other fragments.[75] Kumar et al[76]estimated the goods of T. arjuna dinghy Excerpt on myocardial fibrosis and oxidative stress convinced by habitual b-Adrenoceptor stimulation. Because myocardial fibrosis and oxidative stress Accompany a number of cardiac diseases similar as hypertrophic cardiomyopathy, Hypertensive heart complaint and cardiac failure. Waterless excerpt of T. arjuna Dinghy was estimated at [63], 125 and 250 mg/ kg given orally for antifibrotic And antioxidant goods in rats given the picky b- adrenoceptor agonist isoprenaline For 28 days. The arjuna dinghy excerpt significantly averted the isoprenalineInduced increase in

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oxidative stress and decline in endogenous antioxidant Position and also averted fibrosis. Gauthaman et al[79]studied that oral Administration of T. arjuna for 12 weeks in rabbits caused addition of myocardial Antioxidants; superoxide dismutase(SOD), catalase(CAT) and glutathione(GSH) on with induction of heat shock protein72(HSP72). In vivo ischemic-Reperfusion injury convinced oxidative stress, towel injury of heart and Hemodynamic goods were averted in the arjuna treated rabbit hearts. Alcoholic Excerpt ofT. Arjuna dinghy and its excerpts were estimated for DNA protection, Protein oxidation and free radical scavenging exertion. Ethanolic excerpt ofT. Arjuna dinghy(TAA) and its fragments, including dichloromethane(TAD), ethyl Acetate(TAE), butanol(TAB) and water(TAW) has significant antioxidant Exertion and implicit to help protein oxidation, DNA damage protection by pBR 322 DNA and SCGE assay. The potent antioxidative exertion and DNA Protection capability of T. arjuna dinghy excerpts might be championed with Phenolic/ flavonoid composites. A significant correlation was also observed Between free radical scavenging exertion, in vitro DNA damage exertion and the Total phenolic/ flavonoid happy.[16] Physicochemical property and inotropic Effect of the waterless excerpt of T. arjuna dinghy(TAAqE) were delved by Oberoi et al80 on adult rat ventricular myocytes in comparison with from Himalayan Herbal Healthcare, Bangalore, India twice a day in addition to Entering the conventional treatment. A significant drop in serum triglycerides as Well as in colorful seditious cytokines similar as hsCRP, IL- 18($P<0.001$), IL- 6 And TNF- a($P<0.05$) was observed at 3 months in cases who were on medicine Treatment excerpts prepared successionally with organic excerpts. They set up That TAAqE decoctions wielded positive inotropy, accelerated myocyte Relaxation and increased caffeine- convinced compression attention dependently. TAAqE- convinced cardiotonic action via enhancing SR function, a unique action Minimizing the circumstance of arrhythmias, makes TAAqE a promising and Fairly safe cardiotonic salutary to the healthy heart and the treatment for habitual Heart complaint. Mandal et al[77] delved antioxidative and antimicrobial parcels Of methanolic excerpt ofT. Arjuna dinghy. The antimicrobial exertion showed that Advanced inhibition against Gram negative bacteria than gram positive bacteria And showed a promising antioxidant exertion, as immersion of DPPH Revolutionaries dropped in DPPH free radical scavenging assay. Methanol Excerpt from dinghy of arjuna displayed medicinal as well as physiological Conditioning. Methanol, ethanol, acetone, waterless both hot and cold excerpts From the leaves and dinghy of T. arjuna were tested for their antimicrobial Exertion against Staphylococcus aureus, Acinetobactersp., Proteus mirabilis, Escherichia coli, Pseudomonas aeruginosa and Candida albicans, pathogens Causing observance infections. Three organic detergents estimated, acetonic Splint excerpt was set up to be stylish againstS. Aureus. Organic dinghy excerpt Showed nearly equal inhibition of all tested Gram negative bacteria exceptP. Aeruginosa. Waterless excerpt of T. arjuna dinghy displayed good activit.

B. Clinical Studies

Lately, Kapoor etal19 delved the remedial eventuality of T. arjuna on the seditious Labels in subjects with stable coronary roadway complaint (CAD). In a placebo-Controlled, randomized double-eyeless study, 116 cases with stable CAD who Were on standard cardiac specifics for further than three months were enrolled And entered either placebo or 500 mg of T.

TOXICITY AND SIDE EFFECTS

Arjuna has been used in the cure between 1 to 2 g per day in different clinical Studies and set up that this is an optimum cure in the cases particularly CAD. These boluses have lower side effect like headache, mild gastritis and Constipation. There were no reports in the respects of hematological, hepatic, Metabolic and renal toxin after further than two times of its administration.83 Lately Bhawani et al82 reported that there was no significant variation in the body And organ weights between the control and the treated group of 93 cases with Dilated cardiomyopathy(DCMP) of idiopathic and ischemic cause was observed After 28 days of treatment under the treatment ofT. Arjuna capsules(500 mg at 8 h). Hematological analysis and biochemical parameters revealed no poisonous goods of the excerpt. Pathologically, neither gross abnormalities nor histopathological changes were observed and there was no mortality recorded in 28 days. Yaidikar et al90 reported that pretreatment with arjunolic acid from theT. Arjuna dinghy effectively averted the cerebral I/ R convinced oxidative damage By virtue oof its antioxidant eventuality and supplementation of arjunolic acid May be salutary in stroke prone population. Arjunolic acid

III. CONCLUSION

On the base of the available literature attestations,T. arjuna is extensively used For

treatment of cardiovascular or conditions, includingheart conditions and Related casket pain, high blood pressure and high cholesterol. It's also used for Earaches and conditions of the urinary tract. The arjuna as ananti-ischemic agent And as a potent antioxidant precluding LDL, reperfusion ischemic injury to the Heart and its implicit to reduce atherogenic lipid situations have been sufficiently Demonstrated in different experimental and clinical studies. Still, the nonstop Exploration progress of using.

REFERENCES

[1]. WHO. World Health Organization, Traditional Medicine Strategy Report, Document WHO/EDM/TRH/2002.1. 2002.
[2]. Heinrich M. Ethnobotany and its role in drug development. Phytother Res.2000;14:479e488.
[3]. Tabuti JRS, Lye KA, Dhillion SS. Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. J Ethnopharmacol. 2003;88:19e44.
[4]. Pieroni A. Evaluation of the cultural significance of wild food botanicalsTraditionally consumed in Northwestern Tuscany, Italy. J Ethnobiol. 2001;21: 89e104.
[5]. Kim H, Song MJ. Ethnomedicinal practices for treating liver disorder of Local communities in the southern regions of Korea. J Evid Based Complement Altern Med. 2013. http://dx.doi.org/10.1155/2013/869176.
[6]. Upadhyay B, Singh KP, Kumar A. Ethnoveterinary uses and informantsConsensus factor of medicinal plants of Sariska region, Rajasthan, India.J Ethnopharmacol. 2011;133:14e25.
[7]. Reyes-Garcia V, Huanca T, Vadez V, Leonard W, Wilkie D. Cultural, Practical, and economic value of wild plants: a quantitative study in The Bolivian, Amazon. Econ Bot. 2006;60:62e74.
[8]. Gosh A. Herbal folk remedies of Bantura & Medinipur districts, West Bengal (India). Indian J Tradit Knowl. 2003;2:393e396.
[9]. Stickel F, Schuppan D. Herbal medicine in the treatment of liver diseases.Dig Liver Dis. 2007;39:293e304.
[10]. Gopinath K, Venkatesh KS, Ilangovan R, Sankaranarayanan K, Arumugam A. Green synthesis of gold nanoparticles from leaf extract Of Terminalia arjuna, for the enhanced mitotic cell division and Pollen germination activity. Ind Crop Prod. 2013;50:737e742.
[11]. Yallappa S, Manjanna J, Sindhe MA, Satyanarayan ND, Pramod SN, Nagaraja K. Microwave assisted rapid synthesis and biological evaluation Of stable copper nanoparticles using T. arjuna bark extract. Spectrochim Acta A. 2013;110: 108e115.
[12]. Edison TJI, Sethuraman MG. Instant green synthesis of silver Nanoparticles using Terminalia chebula fruit extract and evaluation Of their catalytic activity on reduction of methylene blue. Process Biochem. 2012;47:1351e1357.
[13]. Sharma J, Gairola S, Gaur RD, Painuli RM. The treatment of jaundice withMedicinal plants in indigenous communities of the Sub-Himalayan Region of Uttarakhand, India. J Ethnopharmacol. 2012;143:262e291.
[14]. Ram A, Lauria P, Gupta R, Kumar P, Sharma VN. Hypocholesterolaemic Effects of Terminalia arjuna tree bark. J Ethnopharmacol.1997;55:165e169.
[15]. Bachaya HA, Iqbal Z, Khan MN, Jabbar A, Gilani AH, Din IU. In vitro And in vivo anthelmintic activity of Terminalia arjuna bark. Int J Agric Biol. 2009;11: 273e278.
[16]. Phani Kumar G, Navya K, Ramya EM, Venkataramana M, Anand T,Anilakumar KR. DNA damage protecting and free radical scavenging Properties of Terminalia arjuna bark in PC-12 cells and plasmid DNA. Free Radic Antioxid. 2013;3:35e39.
[17]. Dwivedi S. Terminalia arjuna Wight &Arn.-a useful drug for Cardiovascular disorders. J Ethnopharmacol. 2007;114:114e129.
[18]. Maulik SK, Talwar KK. Therapeutic potential of Terminalia arjuna in Cardiovascular disorders. Am J Cardiovasc Drugs. 2012;12:157e163.
[19]. Kapoor D, Vijayvergiya R, Dhawan V. Terminalia arjuna in coronary Artery disease: ethnopharmacology, pre-clinical, clinical & safety Evaluation. J Ethnopharmacol. 2014;155:1029e1045.
[20]. Sharma PC, Yelne MB, Dennis TJ. Database on Medicinal Plants Used in Ayurveda. New Delhi: CCRAS (The Central Council for Research in Ayurvedic Sciences);2005.
[21]. Chopra RN, Chopra IC, Handa KL, Kapur LD. Terminalia arjuna W&A(Combretaceae). In: Chopra RN, Chopra IC, Handa KL, Kapur LD, eds. Chopra's Indigenous Drugs of India.

1st ed. Calcutta, India: UNDhur & Sons; 1958:421e424.
[22]. Nadkarni AK. Indian Materia Medica. 1st ed. Mumbai, India: Popular Prakashan; 1976.
[23]. Ali M. Text Book of Pharmacognosy. 1st ed. New Delhi: CBS Publishers; 1994.
[24]. Row LR, Murty PS, SubbaRao GSR, Sastry CSP, Rao KVJ. Chemical Examination of Terminalia arjuna: Part-XII: isolation and structure Determination of arjunic acid, a new trihydroxytriterpene carboxylic Acid from Terminalia arjuna bark. Indian J Chem. 1970;8:716e721.
[25]. Honda T, Murae T, Tsuyuki T, Takahashi T, Sawai M. Arjungenin, Arjunglucoside I and arjunglucoside II, a new triterpene and new Triterpene-glucosides from Terminalia arjuna. Bull Chem Soc Jpn. 1976;49:3213e3218.
[26]. Singh DV, Verma RK, Gupta MM, Kumar S. Quantitative determination Of oleane derivatives in Terminalia arjuna by high performance thin Layer chromatography. Phytochem Anal. 2002;13:207e210.
[27]. Singh DV, Verma RK, Singh SC, Gupta MM. RP-LC determinationof Oleane derivatives in Terminalia arjuna. J Pharm Biomed Anal. 2002;28:447e452.
[28]. Anjaneyulu ASR, Prasad AVR. Structure of terminic acid, a dihydroxy-Triterpene carboxylic acid from Terminalia arjuna. Phytochemistry. 1983;22:993e998.
[29]. Singh B, Singh VP, Pandey VB, Rucker G. A new triterpeneglycoside fromTerminalia narjuna. Planta Med. 1995;61:576e577.
[30]. Wang W, Ali Z, Shen Y, Li X, Khan IA. Ursane triterpenoids from the bark Of Terminalia arjuna. Fitoterapia. 2010;81:480e484.
[31]. Row LR, Murty PS, Subba Rao GSR, Sastry CSP, Rao KVJ. Chemical Examination of Terminalia arjuna: Part-XII: Isolation and structure Determination of arjunetin from Terminalia arjuna bark. Indian J Chem. 1970;8:772e775.
[32]. Honda T, Murae T, Tsuyuki T, Takahashi T. The structure of arjungen: a New sapogenin from Terminalia arjuna. Chem Pharm Bull. 1976;24:178e180.
[33]. Sharma PN, Shoeb A, Kapil RS, Popli SP. Arjunolone: a new flavones From stem bark of Terminalia arjuna. Indian J Chem. 1982;21B:263e264.
[34]. Tripathi VK, Pandey VB, Udupa KN, Rucker G. Arjunolitin, a triterpene Glycoside from Terminalia arjuna. Phytochemistry. 1992;31:349e351.
[35]. Ali A, Kaur G, Hayat K, Ali M, Ather M. A novel naphthanolglycoside fromTerminalia arjuna with antioxidant and nitricoxide inhibitory activities. Pharmazie.2003;58:932e934.
[36]. Ali A, Kaur G, Hamid H, et al. Terminoside A, a new triterpineglycoside From the bark of Terminalia arjuna inhibits nitricoxide production in Murine macrophages. J Asian Nat Prod Res. 2003;5:137e142.
[37]. Wang W, Ali Z, Li XC, Shen Y, Khan IA. Triterpenoids from two Terminalia species. Planta Med. 2010;76:1751e1754.
[38]. Patnaik T, Dey RK, Gouda P. Isolation of triterpenoidglycoside fromBark of arjuna using chromatographic technique and investigation of Pharmacological behavior upon muscle tissues. E-J Chem. 2007;4:474e479.
[39]. Alam MS, Kaur G, Ali A, Hamid H, Ali M, Athar M. Two new bioactive oLeanane triterpene glycoside from Terminalia arjuna. Nat Prod Res. 2008;22: 1279e1288.
[40]. Ahmad MU, Mullah KB, Norin T, Ulla JK. Terminoic acid, a new Trihydroxytriterpene carboxylic acid from bark of Terminalia arjuna. Indian J Chem.1983;22:738e740.
[41]. Pettit GR, Hoard MS, Doubek DL, et al. Antineoplastic agents 338. The Cancer cell growth inhibitory. Constituents of Terminalia arjuna (Combretaceae). J Ethnopharmacol. 1996;53:57e63.
[42]. Anonymous. Terminalia arjuna. Altern Med Rev. 1999;4:436e437.
[43]. Saha A, Pawar VM, Jayaraman S. Characterization of polyphenols in Terminalia arjuna bark extract. Indian J Pharm Sci. 2012;74:339e347.
[44]. Takahashi SH, Tanaka H, Hano Y, ItoK T, Nomura T, Shigenobu K. Hypotensive effects in rats of hydrophilic extract from Terminalia Arjuna containing tanninrelated compounds. Phytother Res. 1997;11:424e427.
[45]. Lin TC, Chien SC, Chen HF, Hsu FL. Tannins and related compounds fromCombretaceae plants. Chin Pharm J. 2001;52:1e26.
[46]. Kuo PL, Hsu YL, Lin TC, Lin LT, Chang JK, Lin CC. Casuarinin from the Bark of Terminalia arjuna induces apoptosis and cell cycle arrest in Human breast adenocarcinoma MCF-7cells. Planta Med. 2005;71:237e243.

[47]. Dwivedi S, Udupa N. Terminalia arjuna: pharmacognosy, phytochemistry,Pharmacology and clinical use: a review. Fitoterpia. 1989;60:413e420.
[48]. Anjaneyulu ASR, Prasad AVR. Chemical examination of the roots of Terminalia arjuna characterization of two new triterpenoidglycoside. Indian J Chem.1982;21:530e533.
[49]. Anjaneyulu ASR, Prasad AVR. Chemical examination of roots of Terminalia arjuna-the structure of arjunoside III andarjunoside IV, two New triterpenoid glycosides. Phytochemistry. 1982;21:2057e2060.
[50]. Choubey BK, Srivastava SK. Antifungal agents from Terminalia arjuna. Indian J Chem. 2001;40B:354e356.
[51]. Upadhyay RK, Pandey MB, Jha RN, Singh VP, Pandey VB. Triterpene Glycoside from Terminalia arjuna. J Asian Nat Prod Res. 2001;3:207e212.
[52]. Rastogi RP, Mehrotra BN. Compendium of Indian Medicinal Plants. Vol.
[53]. New Delhi: CSIR; 1993.
[54]. Yadava RN, Rathore K. A new cardenolide from the seeds of Terminalia Arjuna (W and A). J Asian Nat Prod Res. 2000;2:97e101.
[55]. Harbone JB. Phytochemical Methods. 3rd ed. London: ChapmanandHall; 1998:117e119.
[56]. Chitlange SS, Kulkarni PS, Patil D, Patwardhan B, Nanda RK. High-Performance liquid chromatographic fingerprint for quality control Of Terminalia arjuna containing Ayurvedic churna formulation. J AOAC Int. 2009;92:1016e1020.
[57]. Kokkiripati PK, Kamsala RV, Bashyam L, et al. Stem-bark of Terminalia Arjuna attenuates human monocytic (THP-1) and aortic endothelial Cell activation.J Ethnopharmacol. 2013;146:456e464.
[58]. Kandil FE, Nassar MI. A tannin anti-cancer promotor from Terminalia Arjuna. Phytochemistry. 1998;47:1567e1568.
[59]. Wang W, Ali Z, Li XC, Shen Y, Khan IA. 18,19-Secooleananetype Triterpeneglycosylesters from the bark of Terminalia arjuna. Planta Med. 2010;76: 903e908.
[60]. Fuhrman B, Aviram M. Antiatherogenecity of nutritional compounds. I Drugs. 2001;4:82e92.
[61]. Carluccio MA, Sicuella L, Ancora MA, et al. Olive oil and red wine Antioxidant polyphenols inhibit endothelial activation: antiatherogenic Properties of Mediterranean diet phytochemicals. Arterioscler Thromb Vasc Biol. 2003;23:622e629.
[62]. Ruff JC. Wine and polyphenols related to platelet aggregation and Atherothrombosis. Drugs Exp Clin Res. 2003;25:125e131.
[63]. Martikainen JA, Ottelin A-M, Kiviniemi V, Gylling H. Plant stanol esters Are potentially cost-effective in the prevention of coronary heart Disease in men:Bayesian modeling approach. Eur J Cardiovasc Prev Rehabil. 2007;14:265e272.
[64]. Bajpai M, Pande A, Tewari SK, Prakash D. Phenolic contents and Antioxidant activity of some food and medicinal plants. Int J Food Sci Nutr. 2005;56:287e291.
[65]. Kolodziej H, Kiderlen AF. Anti-leishmanial activity and Immunemodulatory effects of tannins and related compounds onLeishmania parasitized RAW264.7 cells. Phytochemistry.2005;66:2056e2071.
[66]. Chaudhari M, Mengi S. Evaluation of phytoconstituents of Terminalia Arjuna for wound healing activity in rats. Phytother Res. 2006;20:799e805.
[67]. Varghese A, Savai J, Pandita N, Gaud R. In vitro modulatory effects of Terminalia arjuna, arjunic acid, arjunetin and arjungenin on CYP3A4,CYP2D6 and CYP2C9 enzyme activity in human liver microsomes. Toxicol Rep. 2015;2:806e816.
[68]. Pawar RS, Bhutani KK. Effect of oleananetriterpenoids from Terminalia Arjuna: a cardioprotective drug on the process of respiratory oxyburst. Phytomedicine. 2005;12:391e393.
[69]. Singh G, Singh AT, Abrahama A, et al. Protective effects of Terminalia Arjuna against doxorubicin-induced cardiotoxicity. J Ethnopharmacol. 2008;117:123e129.
[70]. Viswanatha GL, Vaidya S, Ramesh C, Krishnadas N, Rangappa S. Antioxidant and antimutagenic activities of bark extract of Terminalia Arjuna. Asian Pac Jtrop Med. 2010;3:965e970.
[71]. Ahmad MS, Ahmad S, Gautam BJ, Arshad M, Afzal M. Terminalia arjuna, A herbal remedy against environmental carcinogenicity: an in vitro and In vivo study. Egypt J Med Hum Genet. 2014;15:61e67.
[72]. Gauthaman K, Maulik M, Kumari R, Manchanda SC, Dinda AK, Maulik SK. Effect of chronic treatment with bark of Terminalia arjuna: a study On the isolated ischemic- reperfused rat heart. J Ethnopharmacol. 2001;75:197e201.

[73]. Khaliq F, Parveen A, Singh S, Gondal R, Hussain ME, Fahim M. Improvement in myocardial function by Terminalia arjuna in Streptozotocin- induced diabetic rats: possible mechanisms. J Cardiovasc Pharmacol Ther. 2013;18:481e489.
[74]. Sinha M, Manna P, Sil PC. Terminalia arjuna protects mouse hearts againstSodium fluoride-induced oxidative stress. J Med Food.2008;11:733e740.
[75]. Parveen A, Babbar R, Agarwal S, Kotwani A, Fahim M. Terminalia arjuna EnhancesBaroreflex sensitivity and myocardial function in isoproterenolinducedChronic heart failure in rats. J Cardiovasc Pharmacol Ther. 2012;17:199e207.
[76]. Subramaniam S, Ramachandran S, Uthrapathi S, Gnamanickam VR, Dubey GP.Anti-hyperlipidemic and antioxidant potential of different Fractions of Terminalia arjuna (Roxb.) bark against PX-407 induced Hyperlipidemia. Indian J Exp Biol. 2011;49:282e288.
[77]. Kumar S, Enjamoori R, Jaiswal A, Ray R, Seth S, Maulik SK. Catecholamineinduced myocardial fibrosis and oxidative stress is Attenuated by Terminalia arjuna (Roxb.). J PharmPharmacol.2009;61:1529e1536.
[78]. Mandal S, Patra A, Samanta A, et al. Analysis of phytochemical profile of Terminalia arjuna bark extract with antioxidative and antimicrobial
[79]. Aneja KR, Sharma C, Joshi R. Antimicrobial activity of Terminalia arjuna Wight & Arn.: an ethnomedicinal plant against pathogens causing ear Infection. Braz J Otorhinolaryngol. 2012;78:68e74.
[80]. Gauthaman K, Banerjee SK, Dinda AK, Ghosh CC, Maulik SK. Terminalia arjuna (Roxb.) protects rabbit heart against ischemic-Reperfusion injury: role of antioxidant enzymes and heat-shock protein. J Ethnopharmacol. 2005;96: 403e409.
[81]. Oberoi L, Akiyama T, Lee KH, Liu SJ. The aqueous extract, not organic Extracts, of Terminalia arjuna bark exerts cardiotonic effect on adult Ventricular myocytes. Phytomedicine. 2011;18:259e266.
[82]. Devi RS, Narayan S, Vani G, Devi CSS. Gastroprotective effect of Terminalia arjuna bark on diclofenac sodium induced gastric ulcer. Chem Biol Interact.2007;167:71e83.
[83]. Bhawani G, Kumar A, Murthy KSN, Kumari N, Ganapati Swami Ch. A Retrospective study of effect of Terminalia arjuna and evidence based Standard therapy on echocardiographic parameters in patients of Dilated cardiomyopathy. J Pharm Res.2013;6:493e498.
[84]. Bharani A, Ganguli A, Bhargava KD. Salutary effect of Terminalia arjuna In patients with severe refractory heart failure. Int J Cardiol. 1995;49:191e199.
[85]. Dwivedi S, Aggarwal A, Agarwal MP, Rajpal S. Role of Terminalia arjuna In Is chemic mitral regurgitation. Int J Cardiol. 2005;100:507e508.
[86]. Bharani A, Ganguli A, Mathur LK, Jamira Y, Raman PG. Efficacy of Terminalia arjuna in chronic stable angina. Indian Heart J. 2002;54:441e444.
[87]. Rao BCS, Singh RH, Tripathi K. Effect of Terminalia arjuna (W&A) on Regression of LVH in hypertensives: a clinical study. J Res Ayurveda Siddha. 2001;22:216e227.
[88]. Khalil S. Effect of Statin Versus Terminalia arjuna on Acute Myocardial Infarction (DNB thesis). New Delhi, India: National Board of Examination; 2005.
[89]. Gupta R, Singhal S, Goyle A, Sharma VN. Antioxidant and Hypocholesterolaemic effects of Terminalia arjuna tree-bark powder: a Randomised placebocontrolled trial. J Assoc Physicians India. 2001;49:231e235.
[90]. Bharani A, Ahirwal K, Jain N. Terminalia arjuna reverses impaired Endothelial function in chronic smokers. Indian Heart J. 2004;56:123e128.
[91]. Yaidikar L, Thakur S. Arjunolic acid, a pentacyclic triterpenoidal saponin Of Terminalia arjuna bark protects neurons from oxidative stressAssociated damage in focal cerebral ischemia and reperfusion. Pharmacol Rep. 2015;67:890e895.
[92]. Al-Gayyar MMH, Al Youssef A, Sherif IO, Shams MEE, Abbas A. Protective effects of arjunolic acid against cardiac toxicity induced by oral Sodium nitrite: effects on cytokine balance and apoptosis. Life Sci. 2014;111:18e26.
[93]. Parmar HS, Panda S, Jatwa R, Kar A. Cardio-protective role of Terminalia Arjuna bark extract is possibly mediated through alterations in Thyroid hormones. Pharmazie. 2006;61:793e795.