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Original Research Article

Ethnopharmacological review of arjuna

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ABSTRACT

The use of herbal medicines alone or in combination is increasing in human health care. Medicinal plants may be an important source of previously unknown chemicals with potential therapeutic effects. Terminalia arjuna bark is commonly known as Arjuna or Arjun bark and is abundant throughout India. This plant contains 15% tannins, triterpenoid saponins, flavonoids, calcium, aluminium and magnesium salts as well as colorants and sugars which are other components of Arjun. The Terminalia arjuna plant has many therapeutic properties and is capable of treating many ailments, especially heart and circulatory system diseases. This plant is an excellent means of lipid-lowering, anticoagulant, antihypertensive, antiviral, antithrombotic, antifungal and antibacterial. The plant's therapeutic properties related to heart health are due to the triterpenoids enclosed by the arjuna plant. Likewise, the flavonoids and tannins naturally present in this herb have anti-cancer properties. This review provides a key overview of the therapeutic profile, traditional uses, phytochemistry and across different plant parts.

1. Introduction

Terminalia arjuna, commonly known as arjuna, belongs to the family Combretaceae. Its bark decoction is used in the Indian subcontinent to treat angina, hypertension, congestive heart failure, and dyslipidemia, based on the observations of ancient physicians for centuries.[1] According to estimates by the World Health Organization, more than 75% of the world's population is still dependent on medicines derived from plants, often obtained by healers.[2] Arjuna is a powerful herb that has been widely used in Ayurvedic medicine for a very long time. Due to its strong cardiotonic and cardioprotective effects, it is mainly used to treat heart disease.[3] Since ancient times, people have used the therapeutic powers of the bark of the arjuna tree to treat a variety of ailments.[4] Arjuna is a remarkable herb that promotes a healthy heart and eases the effects of anxiety and uncertainty.[5] It improves heart health and controls heart rate.[6] The minerals abundant in arjuna help prevent bone loss and improve bone mineral density. Due to its ulcer-protective activity, it is an effective treatment for ulcers, especially peptic ulcers.[7] It effectively treats bleeding disorders because it regulates bleeding.[8] It benefits more from frequent urination and polyuria because it reduces the frequency of urination. It has strong astringent properties and controls leukemia.[9]

This herbal combination has been shown to be effective in Ayurvedic practices for common cold and flu symptoms such as sneezing and runny nose. It also relieves body aches, headache, cough and fever, improves appetite and body immunity. This formulation provides the combined actions of an antipyretic, analgesic, expectorant, anti-inflammatory and diuretic, thereby relieving the symptoms associated

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with the common cold.[10] Terminalia arjuna Wight & Arn. (Comretaceae) is a plant with important medicinal potential. Traditionally, the plant is used in the processing of various foods. T. arjuna is a very good cholesterol-lowering, lipid-lowering, anticoagulant, antihypertensive, antithrombotic, antiviral, antifungal and antibacterial agent. Different parts of the plant have been studied. on the presence of plant components and pharmacological activity. Many useful plant components have been isolated from T. arjuna. Triterpenoids are mainly responsible for the cardiovascular properties.[11] Ancient Indian physicians used the powdered bark of Terminalia arjuna Wight & Arn. to relieve "hritshool" (angina) and other cardiovascular conditions. Its stem bark has glycosides, large amounts of flavonoids, tannins and minerals. Flavonoids have been found to have antioxidant, anti-inflammatory and lipid-lowering effects while glycosides are cardiac stimulants, making Terminalia arjuna unique among currently used herbal medicines.[12]

1. Taxonomic Classification:[13]
2. Kingdom: Plantae
3. Sub-kingdom: Tracheobionta
4. Divisioni: Magnoliophyta
5. Subdivision: Spermatophyta
6. Class: Magnoliopsida
7. Order: Myrtales
8. Family: Combretaceae
9. Genus: Terminalia
10. Species: T. arjuna
11. Zoological name: Terminalia arjuna

2. Plant Description

Arjuna is a medium-sized deciduous tree that grows up to 20 meters tall. The tree sheds its skin and its wood becomes wood after it completes the peeling. Arjuna leaves are oblong, simple, leathery and grooved. Arjuna flowers grow in spikes and are white. Arjuna fruit has 5-7 wings and is ovate or oblong. Arjuna flower season starts from April to May.[14]

2.1. The leaves

Guava-like leaves - oblong, 4 to 6 inches long and 2 to 3 inches wide, opposite, smooth, and often unequal. There are two glands near the base of the petiole. Margin is grooved with apex at an obtuse or sublevel angle. The base is rounded or cordate. Petiole 0.5 - 1.3 cm.[15]

2.2. Fruits

The fruit is 1 to 1.5 inches in diameter and has 5 to 7 long lobes. They are smooth with five to seven wings, woody and fibrous. Nutty and often notched near the apex, marked by. upward oblique ridges.[16]

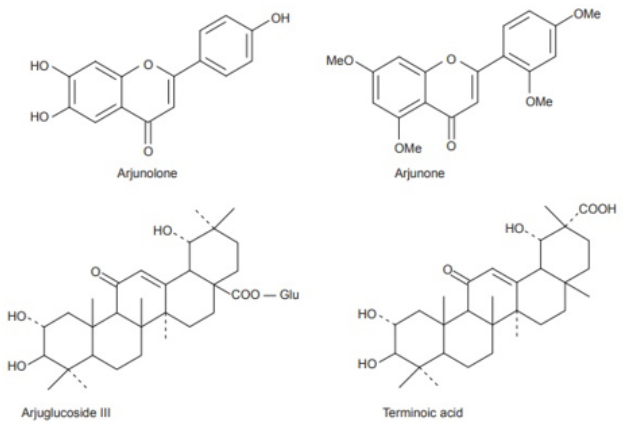
2.3. Bark of terminalia arjuna

It is simple, gray and smooth on the outer surface. The shell is thick, soft, and red from the inside.[17]

3. Chemical Constituents

Arjuna is a member of the family Combretaceae (commonly known as "Arjuna") is a well-known medicinal plant and is found throughout India. Its different aspects have been studied by different researchers and it has been studied for a long time. The tannin content varies from 15–18% in the bark obtained from the lower branches to 20–24% in the dried bark obtained from the stem. Arjuna bark has a mixed tannin form that includes both hydrolyzed tannins and condensed tannins.[18] Epicatechol, epigallocatechol, (+) catechol, (+) gallocatechol and ellgic acid are the tannins that have been reported. From the stem bark, flavonoids such as arjunolone, arjunone and baicaleine have been identified. There have also been reports of the triterpenoid chemicals arjune-tin, arjungenin, arjunglucoside I and II, and terminoic acid from the bark. Arjunosides I and II, terminic acid, oleanolic acid, arjunic acid and other triterpenoids are among those found in the roots. In addition, the fruit contains 7 to 20% tannins. A pentacyclic triterpene glycoside, arjunoglucoside III, has been reported in fruit along with hentriacontane, myristyl oleate and arachidic stearate.[19] Two new pentacyclic triterpenoid glycosides, isolated from the bark of Terminalia arjuna, have been characterized as olean-3α,22β-diol-12-en-28-oic-3-O-β-D-glucopyranosyl (1→4)- β-D-glucopyranoside 1 and olean-3β,6β,22α-triol-12-en-28-oic acid-3-O-β-D-glucopyranosyl (1→4)-β-D-glucopyranoside 2 on muscle by department of spectroscopy data analysis and chemical research.[20] The non-phenolic fraction of the alcohol extract from the root bark of Terminalia arjuna generated two novel triterpenoid glycosides, arjunoside III and arjunoside IV along with arjunglucoside I and arjunetine. The structure of arjunoside III was established as the 28-β-D(+)-glucuronopyanoside of arjunic acid by a study of its chemical and spectral data (1H and

13C NMR) Arjunoside IV was found to be 3- O-α-L(−)-rhamnoside of arjunic acid.[21] Cooper EL (2005) CAM et al. Root of Terminalia alata produced three novel glycosides: 3,3‘-di-O-methylellagic acid 4-O-beta-D-glucopyranosyl-(1–>4)- beta - D-glucopyranosyl-(1–>2)-alpha-L-arabinopyranoside (1), 5,7,2’-tri-O-methylflavanone 4’-O-alpha-L-rhamnopyranosyl-(1–> ; 4)-beta-D-glucopyranoside (2), and 2alpha,3beta, 19beta,23-tetrahydroxyolean-12-ene-28-oic acid 3-O-beta-D-galactopyranosyl-(1–>3) - beta -D-glucopyranoside-28-O-beta-D-glucopyranoside (3). Compounds 2 and 3 exhibited antifungal activity.[22]



4. Anticancer Activity

The active components of the cancer cell line detected were gallic acid, ethyl gallate and flavone luteolin. Previously only gallic acid was known in this plant.[23]

Arjuna bark, the main component of Arjunarishta, has been shown in animal experiments to be useful in reducing tumour growth. More research is need to determine their effectiveness in treating cancer in humans, though.[24]

There have been reports of T. arjuna’s anti-cancer properties. Pestalotiopsis terminaliae, an endophytic fungus, was isolated from T. arjuna leaves and tested for the ability to produce taxol (anticancer drug). The fungus generated a considerable amount of taxol. BT220, H116, Int 407, HL 251, and HLK 210 human cancer cells were strongly cytotoxic to the fungal taxol isolated from an organic extract of the fungal culture in an in vitro apoptosis experiment.[25]

Arjunic acid, arjungenin, and their glycosides, arjunetine and arjunglucoside II, have been isolated from the bark of T. arjuna. Arjungenin and its glucoside showed moderate free radical scavenging activity while all compounds showed no effect on superoxide release from PMN cells. Furthermore, arjungenin also showed a stronger inhibitory effect on hypochlorous acid production from human neutrophils, which suggests that it is a very good cardioprotective drug during respiratory oxyburst.[26]

After TA was administered orally to rabbits for 12 weeks, superoxide dismutase (SOD), catalase (CAT), and glutathione (GSH) levels increased, and heat shock protein was also induced72 (HSP72). A scientific foundation for the putative therapeutic benefit of TA in ischemic heart disease is provided by the prevention of in vivo ischemia-reperfusion, injury-induced oxidative stress, tissue injury of the heart, and hemodynamic effects in the rabbit hearts treated with TA.[27]

In an experiment, on the extract of T. Arjuna cultured human peripheral blood cells, the impact of a bark extract from T. arjuna (TAE) on the modulation of adriamycin (ADR)-induced micronuclei production was investigated. The development of micronuclei was significantly reduced when cells were pretreated with TAE prior to receiving ADR therapy. These results demonstrate that TAE protects DNA against ADR-induced damage.[28]

Human normal fibroblasts (WI-38), osteosarcoma (U2OS), and glioblastoma (U251) cells were grown in vitro with the help of acetone and methanol extracts of T. arjuna. Both extracts suppress the development of transformed cells at doses of 30 g and 60 g mL-1. The tumour suppressor protein, p53, was increased in U2OS but not in U251 or WI-38 cells after extract treatment. It appears that the bark extract of T. arjuna contains elements that can cause growth arrest of transformed cells by p53-dependent and -independent pathways because p21WAF1 was only increased in transformed cell.[29]

Cheng HY, Lin CC, Lin TC (2002) says,Casuarinin, a hydrolyzable tannin isolated from the bark of Terminalia arjuna Linn. (Combretaceae), was investigated for its antiviral activity on herpes simplex type 2 (HSV-2) in vitro. Results showed that the IC(50) of casuarinin in XTT and plaque reduction assays Thus, the selectivity index (SI) (ratio of CC(50) to IC(50)) of casuarinin was 25 and 59 for XTT and plaque reduction assays, respectively. Casuarinin continued to exhibit antiviral activity even added 12 h after infection.[30]

Casuarinin, a hydrolyzable tannin isolated from the bark of Terminalia arjuna L. (Combretaceae), was investigated for its antiproliferative activity in human breast adenocarcinoma MCF-7 cells. The results showed that casuarinin inhibited the proliferation of MCF-7 by blocking cell cycle progression in the G0/G1 phase and inducing apoptosis. An enzyme-linked immunosorbent assay showed that casuarinin increased the expression of p21/WAF1 concomitantly as the MCF-7 cells underwent G0/G1 arrest.[31]

5. GIT and Cardiovascular Activity

Rose J, Treadway S says, the body needs constant nutrition to ensure the normal functioning of the cardiovascular system. However, 60 million Americans have cardiovascular disease (CVD), which includes many

diseases of the heart and blood vessels such as chronic venous insufficiency and high blood pressure.[32]

Aqueous extract of Terminalia Arjuna in gastric ulcer induced by H.pylori LPS in rats, and it can be concluded that the aqueous extract shows activity against gastric and gastric ulcer.[33] Nagar A, Gujral VK, Gupta SR et al. studied The inhibitory effect of alcohol and aqueous extracts of TA stem bark was evaluated on 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) of Human reductase, lipoprotein lipase (LpL), and lipid peroxidation in rat liver and heart homogeneity (wistar). H2O2-induced reactive oxygen species (ROS) generation patterns were observed by confocal microscopy and found to be reduced.[34] Dwivedi S, Aggarwal A, Aggarwal MP, Rajpal S (2005) et al. studied that powdered bark of Terminalia arjuna, a native plant, has been shown to have antianginal, decongestant, and lipid-lowering. The role of T. arjuna in ischemic mitral regurgitation (IMR) after acute myocardial infarction (AMI) was evaluated. After 1 and 3 months of follow-up, patients receiving adjuvant T. arjuna showed a significant reduction in IMR in improved condition.[35]

6. Conclusion

It is thus concluded that T. Arjuna has diversified uses in complimentary, Traditional alternative, medicine and ethnopharmacology. The review is ideal for the researchers in these fields and to lay foundation stone for futher use of T. Arjuna in therapeutics.

7. Source of Funding

None.

8. Conflict of Interest

None.

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References

1. Dwivedi S, Chopra D. Revisiting Terminalia arjuna – An Ancient Cardiovascular Drug. *J Tradit Complement Med*. 2014;4(4):224–55.
2. Palhares RM, Drummond G, Brasil MAF, Oliveira M, Cosenza P, Brandão GL. Medicinal plants recommended by the world health organization: DNA barcode identification associated with chemical analyses guarantees their quality. *PLoS One*. 2015;10(5):127866. doi:10.1371/journal.pone.0127866.
3. Bishop S, Liu SJ. Cardioprotective action of the aqueous extract of Terminalia arjuna bark against toxicity induced by doxorubicin. *Phytomedicine*. 2017;36:210–6. doi:10.1016/j.phymed.2017.10.007.
4. Maulik S, Katiyar K. Terminalia arjuna in cardiovascular diseases: making the transition from traditional to modern medicine in India. *Curr Pharm Biotechnol*. 2010;11(8):855–60.
5. Sekhar YC, Kumar GP, Anilakumar KR. Terminalia arjuna bark extract attenuates picrotoxin-induced behavioral changes by activation of serotonergic, dopaminergic, GABAergic and antioxidant systems. *Chin J Nat Med*. 2017;15(8):584–96.
6. Khanna AK, Chander R, Kapoor NK. Terminalia arjuna: an ayurvedic cardiotonic, regulates lipid metabolism in hyperlipaemic rats. *Phytother Res*. 1996;10(8):663–8.
7. Devi RS, Narayan S, Vani G, Devi CS. Gastroprotective effect of Terminalia arjuna bark on diclofenac sodium induced gastric ulcer. *Chem Biol Interact*. 2007;167(1):71–83.
8. Kaur S, Singh S, Anand N, Sabharwal S. Terminalia Arjuna: A Potential Anti-Hyperlipidemic Drug. *Plant Arch*. 2021;21(1):333–40.
9. Greco G, Turrini E, Tacchini M, Maresca I, Fimognari C. The Alcoholic Bark Extract of Terminalia arjuna Exhibits Cytotoxic and Cytostatic Activity on. *Jurkat Leukemia Cells*. 2021;1:56–66.
10. Amalraj A, Gopi S. Medicinal properties of Terminalia arjuna (Roxb.) Wight & Arn.: A review. *J Tradit Complement Med*. 2017;7(1):65–78.
11. Pawar RS, Bhutani KK. Effect of oleanane triterpenoids from Terminalia arjuna-a cardioprotective drug on the process of respiratory oxyburst. *Phytomedicine*. 2005;12(5):391–3.
12. Mandal S, Patra A, Samanta A, Roy S, Mandal A, Mahapatra TD. Analysis of phytochemical profile of Terminalia arjuna bark extract with antioxidative and antimicrobial properties. *Asian Pac J Trop Biomed*. 2013;3(12):960–6.
13. Thakur S, Kaurav H, Chaudhary G. Terminalia arjuna: A Potential Ayurvedic Cardio Tonic. *Int J Res Appl Sci Biotechnol*. 2021;8(2):227–63.
14. Kumar N. Phytopharmacological overview on Terminalia arjuna Wight and Arn. *World J Pharm Sci*. 2014;2(11):1557–66.
15. Hoq MO. A cardio protective medicinal plant Terminalia arjuna: Evidence from the traditional medicine and recent research. *World J Pharma Sci*;12(13):14–9.
16. Gopinath K, Gowri S, Karthika V, Arumugam A. Green synthesis of gold nanoparticles from fruit extract of Terminalia arjuna, for the enhanced seed germination activity of Gloriosa superba. *J Nanostructure Chem*. 2014;4(3):1–1.
17. Ram A, Lauria P, Gupta R, Kumar P, Sharma VN. Hypocholesterolaemic effects of Terminalia arjuna tree bark. *J Ethnopharmacol*. 1997;55(3):165–74.
18. Jain S, Yadav PP, Gill V, Vasudeva N, Singla N. Terminalia arjuna a sacred medicinal plant: phytochemical and pharmacological profile. *Phytochemistry Rev*. 2009;8(2):491–502.
19. Soni N, Singh VK. Efficacy and advancement of Terminalia Arjuna in Indian herbal drug research: A review. *Trends Applied Sci Res*. 2019;14(4):233–75.
20. Singh S, Sharma LK, Sharma SK, Tewari SK. The phytochemistry and pharmacological activity of Terminalia arjuna (Roxb) Wight & Arn. *Med Plants Int J Phytomedicines Related Ind*. 2013;5(3):105–22.
21. Anjaneyulu AS, Prasad AR. Chemical examination of the roots of Terminalia arjuna-the structures of arjunoside III and arjunoside IV, two new triterpenoid glycosides. *Phytochemistry*. 1982;21(8):2057–60.
22. Mandloi S, Srinivasa R, Mishra R, Varma R. Antifungal activity of alcoholic leaf extracts of Terminalia catappa and Terminalia arjuna on some pathogenic and allergenic fungi. *Adv Life Sci Technol*. 2013;8(1):25–32.
23. Pettit GR, Hoard MS, Doubek DL, Schmidt JM, Pettit RK, Tackett LP. Antineoplastic agents 338. The cancer cell growth inhibitory. Constituents of Terminalia arjuna (Combretaceae). *J Ethnopharmacol*. 1996;53(2):57–63.
24. Amalraj A, Gopi S. Medicinal properties of Terminalia arjuna (Roxb.) Wight & Arn.: a review. *J Tradit Complement Med*. 2017;7(1):65–78.
25. Bharti S. Agro-climatic zone-based identification of elite Terminalia arjuna accessions concerning to arjunolic acid production. *SN Appl Sci*. 2021;3(2):1–9.
26. Pawar RS, Bhutani KK. Effect of oleanane triterpenoids from Terminalia arjuna-a cardioprotective drug on the process of respiratory oxyburst. *Phytomedicine*. 2005;12(5):391–4.
27. 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(3):403–12.
28. Greco G, Turrini E, Tacchini M, Maresca I, Fimognari C. The Alcoholic Bark Extract of Terminalia Arjuna Exhibits Cytotoxic and Cytostatic Activity on Jurkat Leukemia Cells. *Venoms Toxins*. 2021;10:56–66.
29. Seetharam RN, Sood A, Mallick AB, Augenlicht LH, Mariadason JM, Goel S. Oxaliplatin resistance induced by ERCC1 up-regulation is abrogated by siRNA-mediated gene silencing in human colorectal cancer cells. *Anticancer Res*. 2010;30(7):2531–9.
30. Cheng HY, Lin CC, Lin TC. Antiherpes simplex virus type 2 activity of casuarinin from the bark of Terminalia arjuna Linn. *Antiviral Res*. 2002;55(3):447–55.
31. Sun J, Liu RH. Cranberry phytochemical extracts induce cell cycle arrest and apoptosis in human MCF-7 breast cancer cells. . *Cancer lett*. 2006;241(1):124–58.
32. Rose JO, Treadway SC. Herbal support for a healthy cardiovascular system. *Clin Nutr Ins*. 1999;6:1–6.
33. Ramya S. Antimicrobial Activity of Aqueous Extracts of Bark, Root, Leaves and Fruits of Terminalia arjuna Wight & Arn. *Ethnobotanical Leaflets*. 2008;2008(1):158.
34. Chopra B, Dhingra AK, Kapoor RP, Prasad DN. Piperine and its various physicochemical and biological aspects: A review. *Open Chem J*. 2016;3(1):75–96.
35. Dwivedi S, Aggarwal A, Agarwal MP, Rajpal S. Role of Terminalia arjuna in ischaemic mitral regurgitation. *Int J Cardiol*. 2005;100(3):507–15.

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