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Therapeutic Properties of *Terminalia Arjuna*: An Overview

[1]Almutazbellah K. Naji, [1]Hiyam Rasheed, [2]Rafal Mahmood, [3]Inas Khudhur Abbas

[1]College of Veterinary Medicine, University of Kirkuk, Kirkuk, Iraq
[2]College of Education for Girls, University of Kirkuk, Kirkuk, Iraq
[3]College of Physical Education and Sport Sciences, University of Kirkuk, Kirkuk, Iraq

E-mail: mutazkhalid@uokirkuk.edu.iq

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Abstract

For thousands of years, Medicinal plants have been used to develop the human culture and treatment for various diseases, Terminalia arjuna is a member of the Combretaceae family, known communally as arjuna. The plant is rich with phytochemicals including luteolin, gallic acid, arjunone, arjunolic acid, arjunic acid, arjungenin, arjunolone, ellagic acid, oligomeric proanthocyanidins (OPCs) and phytosterols. Due to these phytochemicals, T. arjuna was present in most traditional systems such as Unani, Ayurveda and Siddha. The plant's medical components contribute to many biological activities such as anti-inflammatory, antimicrobial and antioxidant, in addition, the plant has a beneficial effect on the cardiovascular system. This article gathers the latest information for T. arjuna lighting on its biological activity and therapeutic properties.

Keywords: Terminalia arjuna, Combretaceae, Ayurveda

Introduction

Terminalia arjuna is a big medicinal plant belong to the family of Combretacaeae the plant is distributed in South Asia especially India, Sire Linka and Burma. The plant is rich with phytochemicals and has many biological activities that are described by Ayurveda (Kumar et al., 2023). Traditionally T. arjuna is used in treating cough leucorrhrea excessive sweating, ulcers, diabetes, tumors, asthma, inflammation and some skin diseases. The bark of the plant contains many phytochemicals including hydrolyzable tannins, triterpenoids acid and glycosides, flavonoids, phenolics and phytosterol (Swain et al., 2023; Haldar et al., 2023). The bark showed promising effects in treating coronary heart disease, hepatic, congenital, ventral viral disease and antioxidant activity (Dutta & Das, n.d.; Prakash, 2023; Hasan et al., 2021).

T. arjuna contain other important components such as arjunic acid, arjunolic acid, arjunglucoside I-III, arjunetine and terminoic acid (Jaiswal et al., 2021). In recent years, we have noticed a high interest in medicinal plants as an alternative to synthetic medicines that have many side effects, which is great importance to discovering the secrets of medicinal plants (Mohamed et al., 2023). Even in the cause of liver disease, the utilization of natural products is increasing because they are safer and more effective than chemical drug (Rahim et al., 2014).

Despite the huge number of studies on T. arjuna the future research is essential to discover the phytochemicals and therapeutics in different plant parts. The current review highlights the T. arjuna pharmacological and therapeutic properties. This article provides a concise overview of the therapeutic properties of T. arjuna.

Physical Description

T. arjuna (Figure 1) is a deciduous evergreen that may reach a height of 6 to 15 meters, the plant has a buttressed trunk, large crown and dangling branch. The bark is thin, smooth and shiny with a greenish- grey color and frequently peeling. The leaves are organized in a sub opposite direction and measure 5-14 × 2-4.5 cm. the flowers are greenish white or creamy in color, the tree flowers from April to July in the Indian environment. The fruit measures 2.3-3.5 cm in length and has a fibrous, woody and glabrous texture (Amalraj & Gopi., 2017; Gupta et al., 2018).

Figure 1. Terminalia arjuna (Housing new desk., 2023)

Global Distribution

T. arjuna grows through the Indian subcontinent, primarily growing on riverbanks, the species can be found in in Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, and Odisha, as well as in southern and central regions of India. Furthermore, it is also found in Sri Lanka, Karachi, Pakistan, Bangladesh, Malaysia, Kenya and Indonesia (Praciak., 2013; Biswas et al., 2011).

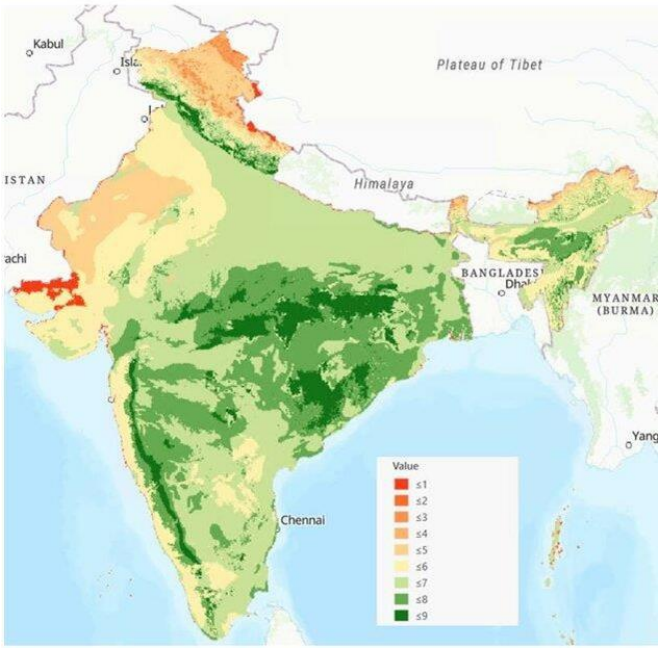

Figure 2. Distribution of Terminalia arjuna in India (Zope et al., 2021)

Table 1. Taxonomical classification of Terminalia arjuna

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Myrtales
Family	Combretaceae
Genus	Terminalia
Species	*Terminalia arjun*

Ethnomedicinal Uses

T. arjuna has been used in Indian Ayurvedic medicine science since ancient times as cardioprotective benefits against angina, hypertension, and arterial deposits traditionally it is used with milk decoction (Kvatha). T. arjuna is used also to treat wounds, bleeding, ulcers, leucorrhea, diabetes, cough, tumor, asthma, inflammation, skin disorders, leucoderma, anemia, and urine discharge. The bark extract of the plant has many properties such as sweetness, acridity, cooling and heating effects, aphrodisiac qualities, expectorant action, tonic properties, styptic effects, antidysenteric properties, purgative action, and laxative effects. Furthermore, the bark has astringent and diuretic properties (P. Thakur et al., 2021).

Pharmacological Properties

Cardiovascular Activity

Pawar et al. performed a study on male Wistar rats to evaluate the effect of T. arjuna extract on cardiotoxicity caused by Doxorubicin (Dox). The rats were given oral dosages of plant extract at different concentrations (0.42, 0.85, 1.7, 3.4, and 6.8 mg/kg) for six days each week. The study showed a significant decrease in cardiac superoxide 38.94% and reduced the glutathione in the rates that were treated with Dox. Electron microscopy screening showed mitochondrial swelling, disruption of Z-bands, localized growth of the smooth endoplasmic reticulum, and the presence of lipid inclusions in the mice treated with Dox (Pawar & Bhutani, 2005). Another study was performed by G. Singh to evaluate the effect of T. arjuna bark powder on the blood biochemistry of chicks. This study employed a group of 72 birds all of whom were 72 days old, the chicken food was enriched with T. arjuna bark powder with 0.50, 0.75 and 1% for 35 days the result showed a decrease in cholesterol, triglycerides, and LDL levels due to the effect of T. arjuna bark powder (G. Singh et al., 2008).

Antimicrobial Activity

Bhatt and Kothiyal performed a study to evaluate the antimicrobial activity of flavonoids derived from the bark of T. arjuna. The result showed that the flavonoid has significant inhibitory activity against of Agrobacterium tumefaciens and Bacillus subtilis (Bhatt & Kothiyal, 2015). Another study showed the antibacterial activity of the leaves and bark extracts of T. arjuna against various pathogens causing ear infections, including Staphylococcus aureus, Acinetobacter sp., Proteus mirabilis, Escherichia coli, Pseudomonas aeruginosa, and Candida albicans. The result showed significant zone inhibition of T. arjuna extracts compared to the positive control (Saha et al., 2012).

Anti-Inflammatory Activity

S. Thakur et al. performed a study to evaluate anti-inflammatory activity by preparing Arjuna Kshirapaka solution following the Ayurvedic principle by using cow milk and then preparing hydroalcoholic bark extract of T. arjuna, the final amount of the Arjuna Kshirapaka solution was determined to be double than hydroalcoholic extract, the study was designed to determine

the ability of T. arjuna to neutralize free radicals and prevent lipid damage in the samples by using (DPPH) 2,2-Diphenyl-1-picrylhydrazylradical free radical scavenging activity and lipid peroxidation inhibition assays. The study revealed that the hydroalcoholic extract of T. arjuna showed significant antioxidant activity in comparison to Arjuna Kshirapaka solution (S. Thakur et al., 2021). Biswas et al. examined the anti-inflammatory activity of T. arjuna leaves by conducting experiments on Wistar albino rats. The leaves were dried, crushed, then mixed with petroleum ether and extracted using methanol. The researchers were generated inflammation on the rats pows by using carrageenan, histamine and dextran, then the rates were given doses of 100 and 200 µl/kg of T. arjuna leaves extract. The study showed that the methanol extract derived from T. arjuna leaves demonstrated noteworthy anti-inflammatory activity in the tested rates (Biswas et al., 2011).

Anti-Diabetic Activity

To evaluate the antidiabetic activity of aqueous bark extract of T. arjuna, Ram performed the study by using blood count, free hemoglobin and total cellular protein of diabetic patient. The result of the study showed that T. arjuna extract reduced the amount of total cellular count and free hemoglobin and enhanced the count of granulocytes in blood and plasma sample of diabetic patients (Ram et al., 1997).

Anti-cancer Activity

For anticancer activity, Takahashi et al. performed a study to evaluate the anticancer activity of T. arjuna by isolation the Pestalotiopsis and Endophytic fungus from the leaves of the plant to examine its ability to produce Taxol compound that is known as highly effective against cancer cells. The result showed that the fungus produced a significant of Taxol 2.11 µg/liter, that have strong cytotoxic activity against of human cancer BT220, H116, Int 407, HL 251, and HLK 210 cell lines (Takahashi et al., 1997; Mahmut et al., 2023).

Antioxidant Activity

D. Singh et al. performed a study to evaluate the hypolipidemic and antioxidative effects of T. arjuna mixed with chocolate and vanilla dairy milk on Wister rats that had hypercholesterolemia for 60 days. The study showed that the T. arjuna have antioxidant activity (D. Singh et al., 2002). Other studies were performed to evaluate the antioxidant activity of T. arjuna alcoholic bark extract by using DPPH free radical scavenging activity. The result showed significant antioxidant activity with the values EC50 of 91 ± 0.160, 50.110 ± 0.150, and 71.00 ± 0.250 µg/ml. The extract also showed the ability to eliminate superoxide radicals prevent lipid peroxidation and decrease the percentage of micronuclei in both polychromatic erythrocytes and a significant decrease in P/N ratio with the EC50 values of 2.471 ± 0.140, 40.500 ± 0.390, and 63.00 ± 0.360 µg/ml respectively in comparison to ascorbic acid (Sawale et al., 2016).

Table 2. Biological activities for Terminalia arjuna

S. No	Extracts	Methods	Properties	References
1	Flavonoids	Agrobacterium tumifacians/Bacillus subtilis	Anti-microbial	(Ramesh & Palaniappan, 2023)
2	Methanol extract	Wister Albino Rat	Anti-inflammatory	(Biswas et al., 2011; Sharma et al., 2000)
3	Bark powder	Extract Chicks	Cardiovascular Activity	(Pawar & Bhutani, 2005)
4	Alcoholic extract	Wister rats	Antioxidant	(D. Singh et al., 2002; Sawale et al., 2016)
5	Aqueous extract	*In-vitro* model	Antioxidant	(Seth et al., 2013)

6	Methanol extract	Rats	Antifeedant	(HONDA et al., 1976)
7	Taxol extracts	*In-vitro* study on BT220, H116, Int 407, HL 251 and HLK 210 human cancer cells	Anti-cancer	(Takahashi et al., 1997)
8	Bark extract	CHF Patient	Diuretic	(Ghosh et al., 2021)
9	Bark powder	CAD Patient	Anti-ischemic	(Chaturvedi, 1967)
10	Bark powder	Patient of Angina & Thrombin Stroke	Anti-ischemic	(Chaturvedi, 1967)

Conclusion

Terminalia arjuna is one of the most important medical plants known in Asia and Africa for its significant therapeutic properties in the treatment of various diseases. The bark of the plant is utilized in Ayurvedic medicine due to its abundance of phytochemicals, including flavonoids, ellagic acid, tannins, oligomeric proanthocyanidins and triterpenoid saponins. Therefore, the plant exhibits many biological activities like antioxidant, anti-inflammatory, anticancer, and antidiabetic effects which are attributed to the presence of these compounds. Additionally, the plant represents an excellent source of minerals such as calcium, zinc, copper and magnesium. In recent years, there has been interest in developing medication derived from natural sources this transition in pharmaceutical manufacturing is due to the negative effects of the medication that is produced by chemical synthesis which gives the medicinal plant additional importance.

The review highlights the medicinal properties of *T. arjuna*, therefore, the authors recommend the people cultivate it as well as increase the research efforts to discover the secrets of this plant that may aid in eliminating modern diseases such as cancer and diabetes.

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