

**REVIEW ON ARJUNA (*TERMINALIA ARJUNA* ROXB.) WITH
SPECIAL REFERENCE TO PRAMEHA (DIABETES)****Satpudke Shweta Shaligram^{1*}, Pansare Tabassum Arif² and Khandekar Surekha
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Dept., Government
Ayurvedic College,
Osmanabad.**ABSTRACT**

Prameha (Diabetes) has become a global problem and also well described in the ancient Indian classics like *Vedas*. As of 2016, an estimated 387 million people have diabetes worldwide. *Arjuna* (*Terminalia Arjuna* Roxb.) is an important medicinal plant used in ayurvedic formulations. Ayurvedic classics texts have mentioned *Arjuna* in treatment of *Prameha* due to its predominance of *Kashaya rasa*, *Katu vipaka* and *Laghu*, *Ruksha guna* and *Kaphashoshan* (*absorption of Kapha*) and *Shothagna* (*anti-inflammatory*) actions. Properties of *Arjuna* like *Pramehaghna* (Anti-diabetic), *Hridya* (Cardio protective), *Medoghna* (Anti-obesity) and *Vrana ropan* (wound healing) are well described in Ayurveda which help to treat co-

morbidities of *Prameha*. The major chemical constituents of *Terminalia arjuna* are Flavonoids, Tannins, Saponins, Alkaloids, Glycosides which explains anti-diabetic activity. *Arjuna* have diverse medicinal properties like Anti-oxidant, Anti- hyperlipidemic, Anti-diabetic, Anti-obesity, Wound healing property, Analgesic activity, Antifungal activity, Anti-inflammation activities useful against Diabetes. *Arjuna* is also screened for effective in diabetic complications like Nephropathy, Cardiovascular autonomic neuropathy. This review gives detail information regarding importance and role of *Arjuna* in treatment of *Prameha* according to *Ayurvedic* and modern pharmacological aspect.

KEYWORDS: Aruna, *Terminalia Arjuna*, *Prameha*, Diabetes.

INTRODUCTION

Prameha (Diabetes) is a major health problem worldwide. Insulin and oral hypoglycemic are the most widely used drugs for diabetes but they have various side effects like hypoglycemia, weight gain, lactic acidosis and they cause liver and renal damage. The controlling of diabetes without side effects is yet a challenge to the medical system. There is an increasing demand to use the natural products with anti-diabetic activity. In the last few years, there has been a tremendous growth in the field of herbal medicinal and these drugs are gaining popularity both in developing and developed countries because of their natural origin and minimum side effects.^[1] *Arjuna* (*Terminalia arjuna* Linn.) is large tropical woody tree distributed throughout India. It is about 20-25 meters tall tree, generally has a buttressed trunk, and forms a wide canopy at the crown from which branches drop downwards.^[2] The *Arjuna* is usually found growing on river bank or near dry river beds in Uttar Pradesh, Madhya Pradesh, West Bengal and South and Central India. Main chemical constituents of *Arjuna* are Tannins, Triterpenoid Saponins, Flavonoids, Gallic acids, Ellagic acid and Phytosterol.^[3] *Arjuna* is uses as cardio tonic and also uses in treating Hypertension, Cirrhosis of liver, Pulmonary tuberculosis, Uterine disorders, Venereal disease, Epilepsy, Chronic fever, Nausea, Diarrhea, Dysentery, Urticarial, Ulcers, Fractured bone and Diuresis.^[4] Bark of *T. arjuna* is used in Ayurveda in treatment of diabetes. *Arjuna* has multi targeted effects on various physiological system of human body. During the intense search in classical texts of Ayurveda, it is found that *Arjuna* is one the common drug has *Pramehaghna* (Anti-Diabetic) property And *T. arjuna* showed its wide acceptance as an anti-diabetic effect.^[5] This review gives detail information about mode of action of *Terminalia Arjuna* in *Prameha* (Diabetes), Its formulations in *Prameha chikitsa* (Treatment of Diabetes), Chemical compositions and Pharmacological actions which are works against Diabetes.

Prameha

The word *Prameha* consists of two words i.e. 'Pra' (upsarga- prefix) and 'Meha'. *Meha* is derived from the root 'Mih secane' by adding 'Lue' pratyay to it 'Mehati, Sinchati Mutraretasi' which means to excrete.^[6] *Shayanacharya* interpreted the word *Mehana* as *Medhra* which denotes to *Shishna* (Penis). In Sanskrit literature the 'Mih' is used to denote, to make water, to wet, to emit semen in reference disease of human body, so this root 'Mih' add to prefix 'Pra' which means the passing of urine in excess by in both term quantity and frequency and it became *Prameha*.^[7]

Prameha Samprapti (Pathophysiology)

In Ayurveda, *Prameha* is the condition caused by impairment of *Kapha Dosha* and *Jala Mahabhoota* i.e. Disturbed metabolism of water compartments in body giving laxity in body tissues especially in fats, muscle tissues giving them *Abadhha* (lax or hypotonic) and *Asamhat* (not compact or loose) consistency. *Kapha Dosha* vitiation mainly hampers fat or lipid metabolism leading formation of *Kleda* (tissue waste products in liquid form dampening the body tissues). Excessive formation of *Kleda*, excessive evacuation of this *Kleda* in form of profuse, cloudy urine '*Prabhut Avil Mutrata*' is cardinal symptom described. This excess *Kleda* brings *Shaithilya* in surrounding tissues like muscles, lymph, marrow, semen, fat and in advance stage putrefy them. Therefore, these tissues are considered as *Dushya* or target tissues of *Prameha*. Formation *Kleda*, disturbed lipid metabolism are key points in pathophysiology of *Prameha* although all three *Dosha* are involved in process.^[8]

Rasa panchaka of Arjuna^[9]*Rasa – Kashaya**Vipaka-Katu**Veerya- Sheet**Guna- Laghu, Ruksha**Prabhav- Hridya (Cardioprotective)**Doshghnata- Kaphapittshamak**Karma-Vranaropak, Sandhankar, Shonitstapana.**Rogaghata- Prameha (Diabetes), Medoroga (Obesity), Shoth (Inflammation), Vrana (Wound).****Arjuna in Prameha Chikitsa****The formulations of Arjuna are described in ayurvedic classics as following***Charaka Samhita-** *Arjuna* described in *Udarda Prashamanmahakashaya* (Anti urticaria) and *Kashayskandha*.^[10]**Table-1: Table showing formulation of Arjuna in Charaka samhita.**

Preparation	Diseases	Reference
1.Arjuna kwatha	Kaphaja Prameha	Charak Samhita Chikitsastana6/27
2.Arjuna kwatha	Pittaja Prameha	Charak Samhita Chikitsastana6/31
3.Trikantakadyaghrita	Kaphaj and vataj Prameha	Charak Samhita Chikitsastana6/38

Sushruta samhita- *Arjuna* described in *Nyagrodhadigana*.^[11]

Table-2: Table showing formulation of Arjuna in Sushruta Samhita.

Preparation	Diseases	Reference
1. Arjuna kwatha	Ikshhumeha	Sushruta Samhita Chititsastana-11/8
2. Arjuna kwatha	Prameha	Sushruta Samhita Chititsastana-11/9

Ashatanghridayam- Acharya Vagbhata described Arjuna in *Nyagrodhadigana* and *Virtarvadi*.^[12]

Table-3: Table showing formulation of Arjuna in Ashtanghridayam.

Preparation	Diseases	Reference
1. Arjuna churna/Leha	Kaphaja Prameha	Ashtang Hridaya Chikitsastana6/53
2. Arjuna kwatha	Mutraghata	Ashtang Hridaya Chikitsastana11/37
3. Arjuna Kasaya	Pittaja Prameha	Ashtang Hridaya Chikitsastana12/8
4. Trikantakadi Taila	Vata and Kaphaj Prameha	Ashtang Hridaya Chikitsastana12/17

Harita Samhita^[13]**Table-4: Table showing formulation of Arjuna in Harita Samhita.**

Preparation	Diseases	Reference
Arjuna kwatha	Kaphaja Prameha	Harita Samhita Tritiyasthana-28/8
Arjuna kwatha	Takrameha	Harita Samhita Tritiyasthana28/9
Arjuna kwatha	Pittaja Prameha	Harita Samhita Tritiyasthana28/13
Arjuna Churna	Madhumeha	Harita Samhita Tritiyasthana28/18-21

Chakradatta- Arjuna has been described in different formulation to treat various disorders. Reference of Arjuna in Prameha are mentioned below.^[14]

Table-5: Table showing formulation of Arjuna in Chakradatta.

Preparation	Diseases	Reference
Nyagrodhadichurna	All types of Prameha	Chakra Datta-33/23
Kaphamehahar kwath	Kaphaja prameha	Chakra Datta-33/23
Arjuna Kashaya	Pittaja Prameha	Chakra Datta -33/23
Trikantakadya taila, Ghrita	Prameha	Chakra Datta -33/23

Bhavprakash -Arjuna has been described in the form of various preparations which are indicated for Prameha treatment.^[15]

Table-6: Table showing formulation of Arjuna in Bhavprakasha.

Preparation	Diseases	Reference
Arjuna twaka	Prameha	Bhavprakash MadhyamKhand. -38/46
Arjuna Kwath	Prameha	Bhavprakash Madhyam Khand-38/50
Nyagrodhadichurna	Prameha	Bhavprakash MadhyamKhand-38/67
Arjuna tail	Prameha	Bhavprakash MadhyamKhand-38/101
Arjunaghrita	Prameha	Bhavprakash MadhyamKhand-38/102

Bhaisajyaratnavali- *Arjuna* described as below.^[16]

Table-7: Table showing formulation of *Arjuna* in Bhaisajyaratnavali.

Preparation	Diseases	Reference
<i>Arjuna Twaka</i>	<i>Ichhumeha</i>	Bhaishajya Ratnawali./47
<i>Nyagradhadigana</i>	<i>Bahumutrata</i>	Bhaishajya Ratnawali Bahumutra/2

Yogratnakara- In this, *Arjuna* is mentioned as *Pramehagha* dravya.^[17]

Nighantus

Bhavprakash nighantu- *Arjuna* described under *salasaradivarga* and explained as *Shital*, *Hridya*, *Katukashya* and *Medomehavrananhanti*. And also mentioned its *Kashya* in *rasa* and *Kaphapittaghana*.^[18]

Kaidev nighantu- *Arjuna* mentioned under *Aushadhivarga* for treatment of *Medor Aoga* and *Prameha*.^[19]

Nighantu Adarsha- *Tvaka* and *patra* of *Arjuna* are belongs to *Haritakyadivarga*, and bark to be used for *Prameharoga*.^[20]

Priya Nighantu- Acharya P. V. Sharma has stated that *Arjunakand-twaka* is superior as *Hridrogahari*. But it have also properties of *Prasmehghana*.^[21]

Raj nighantu- *Arjuna* mentioned under *Prabhadradi* varga described as *Kaphaghna*, and *Vrananashana*.^[22]

Dhanvantari nighantu- *Arjuna* mentioned under *Amradi Varga* described as *Kaphapittghna*, *Trishnahara*, *Vrananashaka*.^[23]

Mode of action of *Arjuna* in *Prameha*

The diseases *Prameha* defined in classics as the *Kaphavata* predominance. Even though all three *Dosha* are involved in the *Prameha* manifestation, the *Vata* predominance is understood with hypo functioning of *Agni* (*Mand*) or *Vishamagni*.^[24] This improper *Agni* influence the *Kapha* and *Aam* production into the body. Further, due to unwholesome diet and regimen (*Apathyaaharavihara*) *Kapha*, *Mamsa*, *Meda* get aggravated and cause the obstruction (*Margavarodha*). *Arjuna* with *Kashayarasa* clears the channels due to *kaphashoshan* (Absorbtion of *kapha*) as well as decreases the *Kleda*. *Katu vipaka* helps to increases the

digestion. Thus, it stimulates the *Jatharagni* and regularizes the *Mandagni* which is the main cause of *Prameha*. *Laghu* and *Ruksha* guna clears the *Mala*, *Kleda* from *strotas* and alleviates. So, the *Arjuna* is capable of correcting the *Dhatu* vitiation (*Saithilyata*). Thus, helps in breakdown of *Prameha sampranti* and reduces related symptoms.^[25] Many a times *diabetes existed along with* cardiac disorders, obesity and diabetic wound.^[26] Properties of *Arjuna* like *Pramehaghna* (Anti-diabetic), *Hrudya* (Cardio protective), *Medaghna* (Anti-obesity) and *Vrana ropan* (wound healing) properties are well described in ayurvedic classics. *Kashaya rasa*, *Katu Vipaka*, *Laghu guna* performs *Srotoshodhana karma* which reduces excessive *Kleda* from body as well as clears the channels and improve circulation of *Rasa dhatu*. Thus, alleviation of *kapha* helps to relieve symptoms of *Hrigroga*. With *Kashaya Rasa* and *Sheet Veerya Arjuna* help in wound healing.

Chemical compositions in *Arjuna*^[27]

Bark-Flavonoids, Tannin, Alkaloids.

Stem-Flavonoids, Tannins, Saponins, Alkaloids, Triterpenoids- Arjunin, Arjunic acid, Arjunenin.

Roots- Triterpenoids, Flavonoids

Leaves and seeds- Flavonoids, Glycosides

Relation between Chemical compositions and *Prameha*

Flavonoids- It is important antioxidant and promotes several health effects. Flavonoids in Diabetes usually alternate the diabetes treatment by reducing the aldose reductase, regenerating the pancreatic cells, enhancing insulin release and increasing calcium ion uptake.^[28] The role flavonoids are quite important in fighting with complications of diabetes mellitus than any other method of treatment.^[29] Also, Flavonoids stimulated glycogen synthesis in rat's soleus muscle through mechanisms well known to insulin signal transduction.^[30]

Saponins- Saponins have been found having Pharmaceutical properties of anti-inflammatory, anti-fungal, anti-bacterial, antiviral and anti-diabetes.^[31] In the aspect of anti-diabetes, saponin activates AMPK in a calcium-dependent manner, thus regulating gluconeogenesis and glucose uptake.^[32] Saponins effectively alleviated hyperglycemia in diabetic rats by up-regulating the expression of glucose transporter type 4 (GLUT4) while down-regulated the expression of G6P in insulin signal pathway.^[33]

Alkaloids- Three norditerpenoid alkaloids from the seed had anti-diabetic effect by activating the phosphatidylinositol 3-kinase (P13k)/ Akt insulin signaling pathway and suppressing the protein –tyrosine phosphatase-1B(PTP-1B) in cellular models.^[34] An Indole alkaloid, had hypoglycemic activity by enhancing the glucose uptake and PTP-1B inhibition, implying its therapeutic potential against type 2 diabetes.^[35]

Glycosides- Glycosides shows anti diabetic activity in STZ induced diabetic rats, active principal acted by decreasing the serum α - amylase and lactate dehydrogenase activities, modulates oxidative stress and also reduces glycosylatedhaemoglobin.^[36]

Research on pharmacological actions of Arjuna

Anti-oxidant activity

Study provides an evidence that methanolic extract of *T. arjuna* and ethanolic extract of *T. arjuna* even though having more amount of flavonoid and phenolic content, shows potential antioxidant and free radical scavenging activity. A vitro assays demonstrate that plant extracts are important sources of natural antioxidants, which might be useful as preventive agents against oxidative stress.^[37]

Anti-diabetic activity

Study shows that Oral administrator of *T.arjuna* at dose 250 and 500 mg/kg body weight for 30days shows significantly reduction in glucose. The activity of herokinase and phosphoglucoisomerase were seen significantly decreased, whereas the activity of aldolase was seen significantly increase in diabetic rats, when compared with control rats. Oral administration of *T.arjuna* 500mg/kg body weight for 30 days significantly reversed these values to normal. Administration of *T. arjuna* bark extract resulted in a significant reduction in blood glucose level, when compared with diabetic control animals. The extract containing 500mg/kg body weight showed a better glucose level reduction that 250mg/kg body weight. The mechanism may be through the stimulation of b-cell for elevated secretion of insulin, thereby increasing the utilization of glucose in various tissue.^[38]

Anti- hyperlipidemic activity

Study shows that hypolipidaemic activity of the 50% ethanol extract of bark of *T. arjuna* were evaluated in rats. The 50% v/v ethanol bark extract at the dose of 400mg/kg body weight, substantially reduced the plasma total cholesterol, triglycerides and LDL cholesterol while HDL cholesterol increased in experimental group in comparison with

hypercholesterolemic animal group. A major growth in the activities of lipoprotein lipase and plasma LCAT improve hepatic bile acid formation and thereby increased degradation of cholesterol to neutral sterols. The activities of lipogenic enzymes like HMG-CoA reductase, glucose-6-phosphate dehydrogenase and malate dehydrogenase were significantly decrease. The bark extract of *T. arjuna* has excellent hypolipidaemic activity. The effect seems to be mediated through increased hepatic clearance of cholesterol, down regulation of lipogenic enzymes and inhibition of HMG-CoA reductase.^[39]

Anti-obesity activity

Study shows that rats fed with a variety of highly palatable, energy rich, high carbohydrate food elicited significant increases in body weights. High fat diet has been previously reported to increase energy intake and cause obesity in human as well as animals. In this, high fat diet fed rats exhibited an increased body weight along with a corresponding rise in cholesterol levels. When ethanolic extract of *T. arjuna* combines with ethanolic extract of *P. Nigrum* at the dose 400mg/kg shows significant anti-obesity effect when compared to normal, obese and standard groups.^[40]

Diabetic wound healing property

Wound healing property

Study shows that comparative evaluation of healing activity of ethanolic extract of *T. arjuna* against standard drug dexamethasone. The LD50 of *T. arjuna* was found to be safe up to 2000mg/kg. Thus, it would be safe to use this extract as a wound healing agent. The significant ($p < 0.001$) shows decrease in wound size on day 21 compared to day 0 for standard drug, dexamethasone and *T. arjuna* 400mg treated rat confirmed the good wound healing activity. It shows prominent wound healing in comparison to the control group and dexamethasone pre-treated group rats.^[41]

Analgesic activity

Study shows that, dried and crushed leaves of *T. arjuna* were defatted with petroleum ether and then extracted with methanol. The methanol extract at the doses of 100mg/kg and 200mg/kg body weight was given for evaluation of analgesic activity in experimental animal models. Analgesic activity was assessed by acetic acid induced writhing, hot plate and formalin tests in Swiss albino mice. Aspirin was employed as reference drugs for analgesic study. The study observed that the methanol extract of the leaves of *T. arjuna* demonstrated significant analgesic activity in the tested models.^[42]

Antifungal activity

Aqueous, Alcoholic and ethyl acetate extracts of leaves of *T. arjuna* were tested against plant pathogenic fungi like *Aspergillus flavus*, *Aspergillus niger*, *Alternariabrassicicola*, *Alternaria alternate* and *Helminthosporiumtetramera*. The antifungal activities of all extract were determined by paper disc method. Nearly all the extract was found effective against these fungi.^[43]

Anti-inflammation activity

Study shows that the plant extract decreases the formation of edema induced by carrageenan, as well as reduced the number of writhes in acetic acid induced writhing models and hot test, the stem bark of *T. arjuna* exhibited anti-inflammatory activities.^[44]

Nephro-Protective activity

Study shows that the DPPH free radical scavenging assay indicate that the methanol fraction of *T. Arjuna* bark exhibited strong scavenging activity on the DPPH free radical. So that it contained massive amount of Phyto constitutes which have a powerful antioxidant property which shows anti-uremic, nephron-protective and stress reducing activity. Methanolic fraction of bark *T. Arjuna* contain arjunosides IV which is related to phenolic group compound which possesses highly antioxidant and anti-uretic properties.^[45]

Cardiovascular autonomic neuropathy property

Study shows that Terminalia arjuna, rosuvastatin and insulin significantly reduced oxidative stress and inflammatory cytokine levels in diabetic rats. Results suggest that *T. Arjuna* bark extract stimulate the altered baroreflex sensitivity in diabetic rats possibly through maintaining endogenous anti-oxidant enzyme activities and decreasing cytokine levels.^[46]

Toxicity

No major toxicity has been documented of *T. arjuna*. The result from acute oral toxicity study suggested that ethanolic extract of *T. arjuna* at limit dose of 2000mg/kg did not produce any kind of toxicity in animals. Further administration of *T. arjuna* resulted in reduction of thyroid hormone concentration in euthyroid animals, whereas the hepatic LPO has been increased.^[47]

CONCLUSION

Due to *Kashayarasa*, *Katu vipaka*, it shows *kaphashoshan* property (Absorbition of kapha), Clears the channels by reducing obstructions, and improves the hypo functioning of *Agni*. So *Arjuna* is useful in *Prameha*. Properties of *Arjuna* like *Pramehaghna* (Anti-diabetic), *Hridya* (Cardio protective), *Medoghna* (Anti-obesity) and *Vrana ropan* (wound healing) which help to treat co-morbidities of *Prameha* are well explained in *Ayurveda*. The main chemical constituents of *Terminalia arjuna* are Flavonoids, Tannins, Saponins, Alkaloids, Glycosides which shows anti-diabetic activity. *Arjuna* has been shown to possess multifarious medicinal properties such as Anti-oxidant, Anti- hyperlipidemic, Anti-diabetic, Anti-obesity, Wound healing property, Analgesic activity, Antifungal activity, Anti-inflammation activities which are help against Diabetes. With anti-diabetic activity, *Arjuna* also screened for effective in diabetic complications like Nephropathy, Cardiovascular autonomic neuropathy. We hope this review article will help the scientists working of *Arjuna* in the area of traditional medicines against Diabetes.

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