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THERAPEUTIC POTENTIAL OF *TERMINALIA TOMENTOSA* HYNE EX. ROTH.

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ABSTRACT

Terminalia tomentosa (Syn. *T. alata*) belonging to family Combretaceae is a large deciduous tree widely distributed in Indian peninsular region. It is known by the name of *Asana* in state of Uttar Pradesh and Uttarakhand. It is found growing in Sal forests of Terai region mixed with Sal tree. Alongwith the use of plant for timber, it is being used by traditional healers for the management of a number of health issues. The plant has been screened for various biological activities and has demonstrated promising biological activities viz. Antibacterial, Antioxidant, Anti-inflammatory, Anti-epileptic, Hypoglycemic activities which substantiate its pharmacological properties and therapeutic uses described in ancient texts of Ayurveda. Present paper is an attempt to have an in-depth review of the plant for its therapeutic potential described in classical texts of Ayurveda, use of the plant in Local Health Traditions and biological activities demonstrated in various pharmacological screening studies.

KEYWORDS: *Terminalia tomentosa*, *Ayurveda*, Pharmacology.

INTRODUCTION

Ayurveda is the most ancient codified scientific system of medicine existing till date. It has always been a research oriented science and the fact is reflected by continuous increase in the

number of plants used for therapeutic purposes. Herbal medicines are used from the ancient time to cure the diseases, hence play a significant role among the traditional and modern medicine. Increasing adverse effects of synthetic medicine and insurgence of new epidemics, health care professionals and general public all over the world is looking towards traditional systems of medicine especially Ayurveda to get the solution for newly emerging disease conditions whether infective or related to faulty life style.

The genus *Terminalia* comprise of 200 species.[1] Plants included in this genus have been used traditionally to treat skin rashes, diarrhoea, inflammation, cardiac troubles, respiratory tract problems, GIT troubles, as tonics, different bacterial infections and diseases as morbid as cancer.[2] Many plants are documented for their biological potential as antioxidant, anti-inflammatory, anti-diabetic and cardio-protective agents.[3,4]

Terminalia tomentosa (synonym *Terminalia alata* Heyne ex Roth[5,6] is widely used in traditional medicine and is one of the important medicinal species from this genus *Terminalia*. It is a giant tree found in deciduous forests of the world and widely found in and around South East Asian countries.[3] It can be identified by its fissured & cracked bark and for this reason the plant is also known as 'Crocodile bark tree.[5,7] This plant has multitudinous medicinal properties. The spectrum includes anti-oxidant, anti-diarrheal, antifungal, antihyper-glycemic and anti-leucorrheal activities.[5,8] It has been used in therapeutics in Ayurveda since thousands of years together.

Therapeutic Uses of *Asana* in Classical Texts of Ayurveda

In *Charak Samhita, Asana* has been classified in *Udard-Prasaman Mahakashay* (Group of 10 drugs indicated for the management of urticaria (CS.Su.4.43)[9]; *Acharya Sushruta* has mentioned it in *Salsaradi Gana* (a Group of 21 drugs indicated for the management of Skin diseases, urinary problems (*Prameha*), Anaemia (*Pandu Roga)*, (SS.Su.38.12)[10]; *Pusp varg* (Group of 14 different flowers) indicated as destroyer of Kaph-pitta and skin diseases, (SS.Su.46.284)[10]; in *Ashtang Hridaya* under *Asanadi gana* (Group of 23 drugs indicated for Leucoderma(*Switra*), Anaemia(*Pandu*), Urinary troubles(*Prameha*) (AH.Su.15.19-20)[11]; *Shleshma Nasak Gana* (Group of 7drugs indicated for pacification of *Kapha*)(AH.Su.15.7).

Its twig has been indicated as a toothbrush (*dataun*) for the maintenance of Oro-dental hygiene (CS.Su.5.73).[9]

Its heartwood has been used for the preparation of fermented formulation (*Sarasava*) indicated as general tonic to strengthen mind-body-digestive power (CS.Su.25.48).[9]

Its gum has been indicated to be used as errhine drug (*shirovirechan*) in the management of diseases of supraclavicular part of the body i.e. head (CS.Vi.8.151).[9]

It has been indicated as a rejuvenating drug (*rasayan*) as one among nineteen *rasayan* drugs (CS.Ci.1-2.12).[9]

Its bark has been used as a constituent in the preparation of *Chandanadi taila* indicated in the treatment of fever caused by aggravated *pitta* (CS.Ci.3.258)[9]; its bark has been used as a constituent of *Kshir Vriksha Taila* (oil cooked with herbs) indicated in the management of chronic fever (*JeernaJwar*) (SS.U.39.257).[10]

Alkali prepared from the Ashes of *Asana* tree has been indicated in the management of Bleeding disorders (*Rakta pitta*) (CS.Ci.4.94)[9], Powder of its flowers (*Gayatraadi pusp)* is used in Bleeding disorder *(Rakta pitta*) (SS.U.45.37).[10]

Decoction of *Asana* bark with some other drugs has been indicated in the management of Skin diseases (CS.Ci.7.100)[9], it is a constituent of *Maha Khadir Ghrit* indicated in the treatment of skin diseases (CS.Ci.7.152)[9], and its Semisolid preparation of Asanaadi Drugs (SS.Ci.10.9)[10], a constituent of Preparation of *Lelitakvasaadiyog* (AH.Ci.19.24)[11] and *Kutajaadisiddha haritaki* (AH.Ci.19.37)[11] indicated for the treatment of skin diseases (*Kustha*).

Asana bark is a constituent of *Shyonakadi* decoction / Paste indicated in the treatment of Stiffness in thigh musles (*Urustambha*)(CS.Ci.27.56).[9]

Its heartwood is used as a constituents of *Eladi Ghrit* (Ghee cooked with herbs) indicated in the Cachexia (*Shosh nasak*) (SS.U.41.52).[10]

Its bark has been used as a constituent of *Kshiraadi Taila* (oil cooked with herbs) indicated in premature Greying of hair (*Palitya*) (AH.U.24.37).[11]

Ayaskriti prepared with the Drugs of *Asanadi gana* and *Vatshakadi gana* have been indicated in urinary disorder (*Prameh)* (AH.Ci.12.29).[11]

It is a constituent of *Triphlaadi Guggulu* indicated in the treatment of Fistula-in-ano (*Bhagander*), Urinary disorder (*Prameh*), Diseases of skin (*Kustha*) (AH.U.28.42).[11]

Asana (*Terminalia alata*) in Local health tradition

Due to its widespread distribution this plant has been used in local health tradition in the management of variety of diseases –

- Its bark decoction is internally consumed in Atonic diarrhoea and locally applied in weak indolentulcer.[12]
- Decoction of bark of *Asana* is used as cardiotonic for the treatment of oedema of cardiac originand Diarrhoea.
- Ash obtained by burning its stem and branches is used as detergent.[13]
- Bark is effective in haemorrhages, bronchitis, cardiopathy, dysentery, cough, leucorrhoea and burning sensation. It is also use used in GI disorders and anti-inflammatory purposes.[14,15]
- Bark is useful in verminosis, gonorrhoea, liver diseases, vitiligo and blood diseases.
- Bark, gum and leaves are used in fever and ear ache.[16]
- The bark is bitter & stypic useful in vitiated conditions of pitta, ulcers, vata, fractures, haemorrhages, bronchitis, cardiopathy, strangury, wounds, haemoptysis, cough, leucorrhoea, gonorrhoea & burning sensation.[17]

PHYTOCHEMISTRY

S.N.	Phytoconstituents	Plant parts
1.	Tannins: Arjunic acid, Arjunolic acid, Arjunetin Ellagic acid,Gallic acid.	Bark[18]
2.	Triterpenoids: Oleanolic acid, Botulinic acid.	Bark & roots[19,18]
3.	Steroid: β-Sitosterol.	Bark[19,18]
4.	Flavonoids: Apigenin, Kaempferol, Luteolin, Myricetin, Quercetin, Rutin.	Leaves[20]
5.	Polyphenolic compounds - Barringtogenol and tomentosic acid,Dimethyl ellagic acid, Dimethyl flavellagic acid, 5-aminovaleric acid, Thymin, Quercetin and qynurenic acid, 4-methoxy cinnamic acid, Epigallocatechin, Indole-3-aldehyde, Resveratrol, Chlorogenic acid.	Bark[21,22,23]

Plant extracts showed the presence of different types of phytoconstituents, which include, carbohydrates, alkaloids, cardiac glycosides, anthocyanins, flavonoids (apigenin, kaempferol, luteolin, myrcetin, quercetin, rutin), α & β amyrin, lupeol, mudarine, resins, a nontoxic proteolytic enzyme calotropin, a powerful bacteriolytic enzyme calactin,

phytosterols, tannins, triterpenoids, saponins, proteins, fixed oils and fats.[21,14,15] In addition to that some new constituents like di-n-octyl phthalate, arjunahomo-sesquiterpenol, dibutyl phthalate, di-isobutyl phthalate, terpene glycoside, flacone and chalcone glycoside. The presence of these biologically active compounds is responsible for the therapeutic value of *Terminalia tomentosa*.[24]

PHARMACOLOGICAL ACTIVITIES

Antioxidant - Hypoglycemic activity - Ethyl Acetate fraction (EAF), n-butanol fraction (BF), and water fraction (WF) of *T. alata* trunk barn were investigated for hypoglycemic activity. As reported, these solvent fractions lowered fasting blood glucose concentration in streptozotocin induced diabetic rats at dose of 200mg/kg body weight without inducing loss of body weight which was not observed when experimental rats were treated with Acarbose. Anti-diabetic action was evaluated by measuring fasting blood Glucose activity by determination of digestive enzyme reducing activity. Anti-oxidant property was evaluated using DPPH radical scavenging assay. EAF, BF, WF, fractions possess α- amylase inhibition with IC_{50} values of 0.056 ± 0.01, 0.138 ± 0.005 and 0.022 ± 0.001mg/ml respectively as Compared to acarbose (IC_{50}=0.154 ± 0.02mg/ml). These fractions also showed higher IC_{50} values of α-Glucosidase inhibitory activity. Higher phenolic content was responsible for better antioxidant activity.[25]

Antidiabetic Activity - Alcoholic and Aqueous extract of leaves of *Terminalia tomentosa* [Combretaceae] were evaluated for Hypoglycemic effects on normal and diabetic rats. Crude Aqueous (AqE) and Alcohalic extracts of leaves (ALE) of Terminalia tomentosa were administered to normal and alloxan (120mg/kg, i.p.) or dexamethasone (10mg/kg, i.p.) induced diabetic male albino rats. ALE and AqE had significantly decreased the blood-glucose level in dose dependent manner after repeated administration for seven days.[26]

Antiepileptic Activity – The methanolic extract of *Terminalia tomentosa* generated a significant ($P<0.01$) decrease in the duration of tonic hind limb extensor phase in a dose dependent manner and was equivalent to that of diazepam in the maximal electro shock induced convulsions paradigm. The 150mg/kg dose of TTLME did not show a noticeable impact on the hind limb extensor. No group that received the methanolic extract of TTLME leaf experienced any deaths. Analysis of variance (ANOVA) test was used to determine the length of the tonic hind limb extensor phase.[27]

Anti-inflammatory (Anti-Arthritic) Activity- Presence of various phytochemicals like flavonoids, polyphenols and tannins have been reported in *Terminalia tomentosa* bark. To ascertain practical applicability and validate folk traditional claims, *Terminalia tomentosa* bark was investigated for anti- inflammatory activity and anti-arthritic activity. Researchers conducted experimentation on alcoholic and aqueous extracts of *Terminalia tomentosa* by complete freund's adjuent (CFA) induced arthritis in wister rats. Result showed that *Terminalia Tomentosa* bark at the dose of 500mg/kg orally restored altered blood and serum parameters in CFA induced arthritis in wister rats. It also reported anti- inflammatory potential on carrageen induced hind paw edema and carrageen induced air pouch inflammation models.[28]

Anti-Bacterial Property- Antibacterial property of aqueous, ethanol and methanolic extracts of *T. tomentosa* was evaluated against gram negative bacterias like *S. aureus, E.coli* and *K. pnemoniae* and gram positive bacterias. Researchers showed that ethanolic extract showed highest zone of inhibition on E.coli (19.8mm) and the minimum inhibition zone was observed in aqueous extract against *k. pnemoniae* (7.8mm). On comparison, ciprofloxacin (19-31mm) has possessed the highest zone of inhibition. Thus, leaf extract proved to be potent antibacterial agent against gram positive and gram negative bacteria.[29]

Anti-Oxidant Activity - *Sharma et al*. evaluated the *Terminalia tomentosa* bark Aqueous and Ethanolic extracts to assess in vitro antioxidant and the capacity to scavenge reactive oxygen species. They have chosen nitric oxide, arthophenanthroline, DPPH, ABTS and di-isobutyl phthalate, hydrogen peroxide and superoxide methods for the evaluation. An investigation revealed antioxidant action comparable to the medication ascorbic acid a standard.[30]

Anti-Obesity Activity - The ethanolic extract of *Terminalia tomentosa* bark was given orally to evaluate anti-obesity effect on obese rats (Ramavat Ravindar Naik et al*).* Multiple factors, including plasma glucose, bone mineral concentration and density, changes in body weight and composition, adiponectin, leptin, liver enzymes, tissue and circulatory lipid profiles, lipid metabolic enzymes, mRNA expressions of fatty acid synthase, leptin, and tumour necrosis factor alpha, as well as peroxisome proliferator activated receptor gamma, were evaluated in the presence and absence of extracts in experimental animals. Results indicated that obese rats had decreased body weight and changes to their pathophysiological circumstances. This study showed that by regulating adipokines and hormones related to metabolism, the extracts

might reduce the biochemical, physiological and molecular changes associated with obesity in diet-induced obese rats.[31]

Immunomodulatory and Wound Healing Activity - aqueous bark extract of *Terminalia tomentosa* were tested for their capacity to promote wound healing and reduce bilirubin level (Rutika Mahendarakhamare et al,*)*. Wistar Rats were given phenyl hydrazine and paracetamol as treatments to induce hyperbilirubinemia. Silymarin was chosen as the reference medication. Incision and excision models were utilised to measure percentage wound contractions, tensile breaking strength, and epithelisation days in order to evaluate wound healing properties. The results of the excision study revealed a striking rise in the percentage of wound healing, an increase in wound contraction, and a reduction in the time needed for epithelisation. The results of the incision wound model demonstrated a considerable elevation in the breaking strength of sutured skin.[32]

6- PLANT PROFILE

6.1.Taxonomy

Kingdom	Plants
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Mangnoliophyte
Class	Magnoliopsida dicotyledons
Subclass	Rosidae
Order	Myrtales
Family	Combretaceae
Genus	*Terminalia*
Species	*Terminalia tomentosa*

6.2. Common names

- Indian Laurel
- Black Murdah
- Crocodile Bark Tree

6.3. Synonyms of *Terminalia tomentosa*[5,6]

Sanskrit *Raktarjun*

Hindi	*Saj*				
English	Indian Laurel	**Bengali**	*Asan*	**Gujarati**	
	Sadad	**Kannada**	Karimatti	**Tamil**	Marutamaram **Marathi**
	Shardul				

Morphology - *Terminalia tomentosa* Roxb (ex DC) is a large deciduous tree, 20-35m high & 1m in diameter.[29] The bark is rough, dark grey to black in colour with deep vertical fissures & transverse cracks.[34] Leaves are simple, sub-opposite or the uppermost alternate, thick coriaceous, ovate- oblong or elliptic-oblong, rarely obovate, softly tomentose when young becoming more or less glabrous when mature, with 1-2 glands (which are often turbinate or long stalked) usually on the hay midrib but sometimes absent. Flowers are hermaphrodite and in axillary fulvous-pubescent spikes or terminal panicles. Fruits are 1/2-2 inches long and 3/4 inch wide with 5 broad, coriaceous, brown, glabrous wings striated with numerous straight lines running horizontally from the axis to the edges.[35] The plant is common in the forests, especially in the humid regions of India, including the sub Himalayan tracts of North West provinces, Nepal & Sikkim, also Southwards throughout the Peninsula.[36] It is a prominent part of both dry and moist deciduous forests in southern India up to 1000 m.

CONCLUSION

On critically reviewing the literature, it was observed that the drug *Terminalia tomentosa* has been mentioned in *Ayurvedic* text in many formulations. Similar or near similar uses were reported from the practices of Local Health Traditions. These uses have also been proven experimentally by various pharmacological research studies. The *Terminalia tomentosa* plant has an incredible profile of pharmacological and phytochemical qualities, and the literature that has been published till date confirms the fact. Compounds such as alkaloids, cardiac glycosides, anthocyanins, flavonoids, phytosterols, tannins, triterpenoids & saponins are

reported in significant amount in the plant that contribute to its therapeutic efficacy. Though some studies revealed the profile of phytoconstituents of *T. tomentosa*, but information available is scarce and must be explored further. There is still need of conclusive studies on efficacy, safety and toxicity of the drug for better profiling and potentially satisfactory results.

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