# AN OVERVIEW ON BENEFITS OF ALBIZIA PROCERA

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**ABSTRACT**

Rediscovery of the connection between plants and health is responsible for launching a new generation of botanical therapeutics that include plant-derived pharmaceuticals, multicomponent botanical drugs, dietary supplements, functional foods and plant-produced recombinant proteins. *Albizia procera* is a genus of albizia, the member of legume family (fabaceae) and subfamily mimosoideae. Albizia is a genus of more than 160 species of mostly fast-growing subtropical and tropical trees and shrubs in the subfamily Mimosoideae of the family Fabaceae. *Albizia procera* services in different ways such as shelter, fodder, fibre, ornamental, timber, gum or resin, fuel, reclamation, nitrogen fixing, and also has a therapeutic values like anticancer and anti ulcer activity. It is also useful in treatment of rheumatism, haemorrhage, haemorrhoids, skin diseases and worm infestation. On the other hand, *Albizia procera* has well documented pharmacological activities. This review presents phytochemical constituents, traditional uses, services, pharmacological and biological activities reported for the plant and it will be helpful to explore the knowledge about *Albizia procera* for the researchers.

**Keywords:** *Albizia procera*, Pharmaceuticals, Services, Researchers, Biological activities.

## INTRODUCTION

*Albizia procera* is a genus of albizia, the member of legume family (fabaceae) and subfamily mimosoideae[1]. *Albizia procera* is tree with open canopy, occurs naturally in a wide distribution from India and Myanmar through South-East Asia to Papua New Guinea and Northern Australia[2]. *Albizia procera* is a useful tree for farm and amenity planting, light shade, firebreaks and for the rehabilitation of seasonally dry, eroded and degraded soils, regarded as a soil improver and is used as a nurse tree in tea gardens, coffee and cocoa plantings. In India, the leaves of *Albizia procera* are considered good fodder for most ruminants like cattle, sheep, goats, elephants and deer. *Albizia procera* timber[3] is also suitable for general construction, agricultural implements and household products. It is a suitable source material for paper pulp, giving satisfactory yields of bleached pulp. All parts of the plant are reported to show anti-cancer activity. *Albizia procera* is commonly used in traditional medicines such as spermicidal activity, rheumatism, ulcers, haemorrhage and useful in treating problems of pregnancy and for stomach-ache. Evaluation of pharmacological activities confirmed *Albizia procera* as antioxidant, analgesic, antibacterial, CNS depressant, *in vitro* α-Amylase and α-Glucosidase inhibitor, Anti-HIV-1 integrase activity, Antidiabetic, antidiarrheal and hepatoprotective activitiy.

## ORIGIN AND DISTRIBUTION

*Albizia procera* is widely distributed in India and Myanmar through Southeast Asia to Papua New Guinea and northern Australia. The habitat ranges from monsoon forest, mixed deciduous forest, savannah woodlands, pyrogenic grassland, roadsides, dry gullies, to stunted and seasonal swamp forest. It is commonly found in open secondary forest and in areas with a pronounced dry season.

**Geographic distribution**

**I) Native** : Australia, Brunei, Cambodia, China, India[4,5], Indonesia, Laos, Malaysia, Myanmar, Nepal[6], Papua New Guinea[7,8], Philippines[9], Taiwan, Province of China, Thailand, Vietnam.

**II) Exotic** : Antigua and Barbuda, Bahamas, Barbados, Cuba[10], Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Netherlands Antilles, Panama, Puerto Rico[11-13], St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Sudan, Tanzania, Trinidad and Tobago, Virgin Islands (US)[14], Zimbabwe[15].

**Botanical Description**

*Albizia procera* is a tree with an open canopy, up to 30 m tall and trunk of 35 (60 max.)cm in diameter; bole straight or crooked, up to 9 m. Bark is smooth, pale grey-green, yellowish-green, yellowish-brown or brown with horizontal ridges, under bark green colour, changes to orange just below the surface; inner bark is pink or straw coloured; branches are terete and glabrous. Leaves are bipinnate with 2-5 pairs of subopposite pinnae; rachis is 10-30 cm, glabrous; gland narrowly elliptical, 4-10 mm long, sessile, flat and disc like or concave with raised margins; glabrous; leaflets 5-11 pairs per pinna, opposite, rigidly chartaceous to sub-coriaceous, asymmetrically ovate to sub-rhomboid, base asymmetrical; apex rounded or subtruncate, often emarginate, mucronate; both surfaces sparsely appressed puberulous, rarely glabrous on top side. Inflorescence composed of pedunculate glomerules collected in an axillary, sparsely puberulous panicle up to 30 cm long; flowers are glomerule, sessile, uniform, bisexual. Fruits rich red or reddish-brown in colour, flattened pods, chartaceous, glabrous, with distinct marks over the seeds; mature pods each containing 6-12 seeds, usually remaining on the tree until the whole twig bearing the pods is shed; seeds small, greenish-brown, elliptical to round, flat, with a hard, smooth seed coat.

## PLANT PROFILES AND LITERATURE REVIEW OF *Albizia procera*

**Plant profile**

| | | |
|---|---|---|
| Plant | : | *Albizia procera* (Roxb.) Benth. |
| Synonyms | : | Acacia procera (Roxb.) Willd. |
| | | Mimosa elata Roxb. |
| | | Mimosa procera Roxb. |
| Family | : | Mimosaceae |

**Vernacular Names**

| | | |
|---|---|---|
| Tamil | : | Konda Vagai, Velvagai |
| English | : | Acacia, Albizia, Brown Albizia, Forest Siris, Safed Siris, White Siris |
| Hindi | : | Gurar, Karak, Safed Siris |
| Bengali | : | Koroi |
| Burmese | : | Kokko-Sit, Sit, Sitpen |
| Indonesian | : | Wangkal, Weru |

## TRADITIONAL USES AND SERVICES

**Erosion control:** *Albizia procera* is widely planted for its good soil-binding capacity[16]. In Bangladesh, *Albizia procera* is regarded as a soil improver and is used as a nurse tree in tea gardens, coffee and cocoa plantings[17]**.**

**Shade or shelter:** Occasionally cultivated as shade for tea and coffee plantations. Also acts as a wind and firebreak. In Cuba, it is used as a shade tree over coffee and in the Philippines, farmers conserve trees of *Albizia procera* in the landscape because they cast only a light shade.

**Reclamation:** *Albizia Procera* is Popular for the rehabilitation of seasonally dry, eroded and degraded soils. Its ability to grow on dry, sandy, stony and shallow soils makes it a useful species for afforestation of difficult sites[18]**.**

**Nitrogen fixing:** *Albizia procera* fixes atmospheric nitrogen. It readily forms an association with Rhizobium species, enabling it to thrive in nitrogen-deficient soils[19]**.**

**Ornamental:** *Albizia procera* is a useful tree for farm and amenity planting. Trees are often planted along avenues and in gardens to beautify them[20]**.**

**Boundary or barrier or support:** The branches (twigs) are used by tea planters as stakes for laying out tea gardens. These are found to split well. The species is popular along field borders.

**Timber:** Albizia procera has a large amount of non-durable, yellowish-white sapwood. The heartwood is hard and heavy, light or dark brown, with light and dark bands resembling walnut. It is straight-grained, splits readily, seasons well, works easily and is durable[21]**.** The timber is strong, elastic, tough and hard**.** *Albizia procera* wood is chiefly for makes a good cabinet, furniture, construction, agricultural implements, household products, poles, house posts, truck and bus bodies, packing cases, moulding, carts, cane crushers, carvings, boats, oars, oil presses and rice pounders. It is resistant to several species of termites, including *Bifiditermes beesoni*, *Cryptotermes cynocephalus* and *Coptotermes curvignathus*, although the last is reported in India as a pest[22] of the tree.

**Gum or resin:** When injured, the stem exudes large amounts of a reddish-brown gum that is chemically similar to, and used as a substitute for, gum arabic.

**Fuel:** *Albizia procera* makes excellent charcoal and fuelwood [23]**.** The high rate of biomass production, high proportion of biomass in stem and branches (91%) and observed vigorous coppicing after felling led Lugo *et al.*, (1990) [24] to recommend the species for fuelwood [25] production in Puerto Rico. The calorific value of dried sapwood is 4870 kcal/kg, and that of heartwood 4865 kcal/kg. Excellent charcoal (39.6%) can be prepared from the wood, and it is widely used as a fuel. Pods and fallen leaves should be considered not as undesirable litter but as potential energy sources.

**Fibre:** The chemical analysis of the wood indicates that it is a suitable material for paper pulp. Bleached pulp in satisfactory yields (50.3%) can be prepared from *Albizia procera* wood by the sulphate process. The fibres of *Albizia procera* are short and blending with a long-fibred pulp may be necessary to improve strength properties for some end uses. It is suitable for writing and printing paper (mean fibre length is 0.9 mm, mean fibre diameter is 0.021 mm).

**Fodder:** In the Philippines, cooked leaves are eaten as a vegetable. In times of scarcity the bark can be ground with flour and eaten. In India, the leaves of *Albizia procera* are considered good fodder for most ruminants (cattle, sheep, goats, elephants and deer) and the tree is lopped for fodder in several states. In Australia, it appears that early settlers regarded Albizia procera as a good fodder tree [26-28]**.**

**Poison:** The bark is a source of tannin, but yields are low [29]**.** The pounded bark is used as a fish poison, and the leaves are known to have insecticidal and piscicidal properties. The seeds contain proceranin A, which is toxic to mice and rats when administered parenterally and orally; the interperitoneal LD50 for mice is 15 mg/kg body weight. Hydrocyanic acid has been identified as occurring in the tree.

**Other products:** In the Philippines the wood functions as a cash reserve for farmers, who sell it to local wood carvers.

**Medicinal uses:** All parts of the plant are reported to show anti-cancer activity. The roots contain alpha-spinasterol and a saponin that has been reported to possess spermicidal activity at a dilution of 0.008%. *Albizia procera* is commonly used in traditional medicines [30]**.** A decoction of the bark is given for rheumatism, haemorrhage and it is also useful in the treatment of problems occuring in pregnancy, stomach-ache, diabetes mellitus, sinus etc. Seeds were powdered and used in amoebiasis. It cures urinary tract infection including glycosuria, haemorrhoids, fistula and worm infestation and also suppresses skin diseases. The bark is given with salt to water buffalo as a medicine. Fruits of *Albizia procera* acts as an astringent and diminishes Kapha and Sukra [31]**.** In India, leaves are poulticed on to ulcers [32]**.**

## BIOLOGICAL ACTIVITIES

Traditionally a number of activities are reported from various parts of this plant. A few of them are scientifically proven. Some of the reported studies are following:

### *In Vitro* Free Radical Scavenging Activity

The ethanolic extract of *Albizia procera* was examined for DPPH (α,α-diphenyl-β-picrylhydrazyl) radical scavenging activity, Superoxide anion, Nitric oxide and Hydroxyl radical scavenging activity with reference standard Rutin, Quercetin and ascorbate respectively through in vitro models. *Albizia procera* showed significant free radical scavenging activity than that of various standards. The radical scavenging activity was found to be concentration dependent manner. Ethanolic extract of *Albizia procera* showed strong scavenging activity against free radical compared to various standards [33]**.** These in vitro assays indicate that this plant extract is a better source of natural antioxidant, which might be helpful in preventing the progress of various oxidative stresses.

### Antioxidant Potential, Total Phenolic and Flavonoids Content

*Albizia procera* can be used as easily accessible source of natural antioxidants and as a possible food supplement in pharmaceutical industry**..** The ethanolic extract of *Albizia procera* was showed significant free radical scavenging activity than that of various standards. The greater amount of phenols and flavonoids were found in ethanolic extract of *Albizia procera* than that of other extracts. Our results suggest that *Albizia procera* is a potential source of antioxidant, which might be helpful in preventing the progress of various oxidative stresses[34].

### *In Vivo* Antioxidant Activity

Paracetamol induces the oxidative stress in cell by producing reactive oxygen species. After administration of ethanolic extract of *Albizia procera* in paracetamol treated rats showed significant increase in the levels of antioxidant enzyme such as superoxide dismutase(SOD), catalase (CAT) and non-enzymatic antioxidant glutathione (GSH) when compared with paracetamol induced rats (groupII).Based on the results, it was concluded that the ethanolic extract of *Albizia procera* have significant *in-vivo* antioxidant activity [35]and can be used to protect tissue from oxidative stress.

### Phytochemical Evaluation

This study suggests that phytochemical evaluation of *Albizia procera* shows different types of secondary metabolites such as triterpenoids, carbohydrates, glycosides, phytosterols, phenolic compounds, saponins, tannins and flavonoids were indicated phytopharmaceutical importance. [36].

Bark, leaf and root contain saponin and sapogenin. Hydrolysis of the saponin yields machaerinic acid. Tree contains some HCN. Leaf and fruit have given positive tests for haemolysis. A new pentacyclic triterpenic acid, procera acid was isolated from the seed. The gum contains aldobiuronic acid and the disaccharide 3-O-D-galactopyranosyl –L –arabinose [37]**.** Degraded gum from *Albizia procera* contains D-galactose, D-mannose, D-glucuronic acid, and 4-O-mehtyl D-glucuronic acid [38]**.** Complete methylation and subsequent hydrolysis of the product afford 2,4-di-O-methyl-D-galactose (3 moles), 3,4,6-tri-O-methyl-L-arabinose. Perceragenin $C_{30}H_{46}O_4$ is reported from the seed [39]**.**

### Gas Chromatography-Mass Spectroscopy Analysis

GC-MS chromatogram of ethanolic extract of aerial parts of *Albizia Procera (Roxb.)Benth.* analysis clearly showed the presence of twelve compounds [40]. Chromatogram GC-MS analysis of the ethanolic extract of *Albizia Procera (Roxb.)Benth.* showed the presence of 12 major peaks and the components corresponding to the peaks were determined as follows. 3-O-Methyl-d-glucose [55.38 %] , 1,10- Decanediol [2.31%], 3-Pentanol, 2,3-dimethyl- [0.26%], Decanoic acid, ethyl ester [1.54%], Phytol [3.33%], 1-Undecyne [0.77%], Didodecyl phthalate [2.56%], Squalene [6.15%], 9,12- Octadecadienoic acid (Z,Z)-,phenylmethyl ester [3.85%], 6,9,12 Octadecatrienoic acid, phenylmethylester, (Z,Z,Z)-[4.87%], Benzo [b]thiophene-2 carboxamide, 3-chloro-N-(4-methoxyphenyl)- [8.97%], 13-Tetradece-11-yn-1-ol [10.00 %].The presence of various chemical compounds confirms the application of *Albizia Procera (Roxb.)Benth.* for various ailments by traditional practitioners.

**Analgesic, Antibacterial and CNS Depressant Activities**

Mst. Mahfuza Khatoon *et al.,* results indicated that the extracts could significantly reduce the number of writhing, showing potential anti-nociceptive action and the mechanism by which they exert their analgesic effect probably by inhibiting synthesis or action of any of the above pathway [41]. In order to confirm whether the antinociceptive action was central or peripheral, the extracts were also examined using formalin test method, which was generally considered a central action. The test consists of two different phases: early phase where the pain began due to the direct stimulation of the sensory nerve fibers by the direct action of formalin, and in the late phase, pain induced due to different inflammatory mediators, such as histamine, prostaglandins, serotonin and bradykinins [42]. Central analgesic drugs like narcotics, inhibited equally both phases, while peripherally acting drugs, such as steroids (hydrocortisone and dexamethasone) and NSAIDs (indomethacin), suppresses mainly the late phase [43]. The results obtained here indicated that the extracts inhibited late phase mechanisms of pain, suggesting that the plant extract may act as steroids and NSAIDs. It is also reported that the inhibition of pain may also due to the presence of phenolic constituents [44] which may be due to the similar type of constituents present in the extracts of *Albizia procera* leaves. However, the exact mechanism of this action has not been investigated here.

Locomotor activity refers to an increase in alertness and decrease in locomotor activity considered as sedative effect. In this study, locomotor activity measured by hole cross and open field tests, showed that the extract significantly decreased locomotor activity which indicates it has CNS depressant activity. Diazepam, which was used to induce sleep in this study, believed to act at specific binding sites that are closely linked to γ-aminobutyric acid (GABA) receptors, the binding of benzodiazepines enhancing GABA-ergic transmission. It has been reported that many flavonoids and neuroactive steroids were found to be ligands for the GABA receptors in the central nervous system; that can act as benzodiazepine-like molecules [45]. Preliminary phytochemical studies revealed the presence of glycosides, flavonoids, tannin etc. in methanol extract of *Albizia procera* leaves. So, it is probable that flavonoids present in the extracts may responsible for its CNS depressant activity.

A number of studies have raised the necessity of developing alternative antimicrobial drugs [46, 47]. Plant antimicrobials would appear to be an excellent choice. It has been shown previously that methanol extract of *Albizia procera* stem bark exhibit a potent antimicrobial activity against Bacillus subtilis, Staphylococcus aureus, Staphylococcus epidermidis, and Enterococcus faecalis [48]. No previous report on the antibacterial activity of the leaves of *Albizia procera* could be found in the literature. Use of leaves extract in the current study demonstrated that the leaf also produces antibacterial compounds against Gram-

**Anti-HIV-1 Integrase Activity**

The study explored the ethanol extract had good anti-HIV-1 IN [49, 50] activity with an IC50 value of 19.5 mg/mL, whereas ethyl acetate fraction exhibited the most potent with an IC50 value of 19.1 mg/mL, followed by water fraction (IC50 value ¼ 21.3 mg/mL), hexane and chloroform fractions (IC50 value4100 mg/mL), respectively. From bioassay-guided isolation, the ethyl acetate fraction was further separated to give two compounds which are (+)-catechin (1) and protocatechuic acid (2), respectively. Of the tested samples, (+)-catechin (1) exhibited appreciable activity against HIV-1 IN with an IC50 value of 46.3 mM, whereas protocatechuic acid (2) showed mild activity with 46.0% inhibition at concentration of 100 mM. (+)-Catechin (1) could interact with Thr 66, Gly148, and Glu152 in the core domain of IN enzyme, whereas protocatechuic acid (2) could bind with Thr66, His67, Glu152, Asn155, and Lys159. This is the first report on anti-HIV-1 IN activity of *Albizia procera* bark [51]. These results may suggest that *Albizia procera* bark has potential as anti-HIV-1 IN agent.

**Antidiabetic Activity**

This study was to identify more effective hypoglycemic fractions from chloroform extract of *Albizia procera* stem bark. Isolated fractions of *Albizia procera* stem bark chloroform extract were given individually to different batches of rats both normal (80 mg/kg of b.wt animals) and Streptozotocin induced diabetic rats (160mg/kg b.wt animals) after an overnight fast. The blood glucose levels were measured at 0, 1, 2, 3, 5 and 6 hours after the treatment. Fractions were also treated to Streptozotocin induced diabetic rats by chronically (80mg/kg b.wt). The fractions E of *Albizia procera* stem bark chloroform extract was shown maximum blood glucose lowering effect in both normal and Streptozotocin diabetic rats with acute and chronic treatment. The other fractions are also showing hypoglycemic and antihyperglycemic activity, but the effect is significantly less than that of fraction E. The antihyperglycemic activity of fractions of *Albizia procera* stem bark chloroform extract was compared with the treatment of glibenclamide. The present data confirm the antidiabetic activity of *Albizia procera* in Indian traditional medicine for Diabetes mellitus treatment. The antihyperglycemic action attributed to the presence of valuable flavonoids, terpenoids in the fraction E [52]**.**

**Acute Toxicity Study**

The results of acute toxicity study revealed that LD50 values squalene isolated from *Albizia procera* were high and apparently showed the safety of extract [53]**.** The treatment of rat with squalene isolated from *Albizia procera* did not change any autonomic or behavioural response in rats. The zero percent mortality for squalene isolated from *Albizia Procera* was found at the doses of 500mg/kg. Overall results suggested the LD50 value of 500mg/kg. Hence the therapeutic dose was calculated as 1/10th (50mg/kg) of the lethal dose for hepatoprotective and *in-vivo* antioxidant activity.

**Hepatoprotective Activity**

Paracetamol induced hepatotoxicity on wistar rats showed significant increase ($p<0.001$) in AST, ALT, ALP and GGT ($p<0.01$) in serum levels when compared with control. Elevated levels of serum enzymes leaking out from damaged liver cells into circulating blood represent the damage to hepatic cells [54]. The effect of squalene isolated from *Albizia procera* treatments reversed the level of AST, ALT, ALP and GGT when compared to paracetamol alone treated rats. Silymarin treated animals also showed significant decrease in AST, ALT, ALP and GGT levels, which seem to offer the protection and maintain the functional integrity of hepatic cells [55].

Administration of paracetamol significantly increased the levels of total bilirubin [56], urea and creatinine when compared with control group of rats. The serum total bilirubin, urea and creatinine were significantly decrease in paracetamol with squalene isolated from *Albizia procera* treated rats and as well as standard drug (silymarin) compared with paracetamol induced hepatotoxicity on wistar rats. The effective control of total bilirubin levels indicating its protective effect over liver and improvement in its functional efficiency [57]. Based on the findings, the squalene isolated from *Albizia procera* may enhanced the ability of the kidneys to remove these waste products from the blood as indicated by reduction in serum urea and creatinine levels and confer protective effect on the kidney [58].

The paracetamol administered rats were significantly increased the levels of total cholesterol and triglycerides when compared with control group of rats. Increase in the level of total cholesterol and triglycerides is a risk factor for ischemic heart disease [59]. The serum total cholesterol and triglycerides were significantly decrease in paracetamol with squalene isolated from *Albizia procera* treated rats and as well as standard drug compared with Paracetamol induced hepatotoxicity on wistar rats. The decreased level of triglyceride and total cholesterol are responsible to remove cholesterol from within artery.

The paracetamol induced hepatotoxicity on wistar rats were significantly decrease in the level of total protein and albumin when compared with control group of rats. The decrease in the level of total protein observed in paracetamol induced hepatotoxicity on wistar rats may associated with decrease in the number of hepatocytes, which in turn may result in decreased hepatic capacity to synthesise protein [60]. Albumin is major protein generated by liver and severe liver injury causes decrease in the amount of albumin produced [61]. Treatment of rats with squalene isolated from *Albizia procera* treated rats and as well as standard drug (silymarin) significantly increase the level of total protein and albumin compared with paracetamol induced hepatotoxicity on wistar rats. An increase in serum levels of total protein and albumin suggests the stabilisation of endoplasmic recticulum, leading to protein synthesis [62]. The hepatoprotective effect of squalene isolated from *Albizia procera* was confirmed by histopathological examination of the liver tissue of control and treated animals: paracetamol induced wistar rats shows Hepatocytes show degenerative changes. There are seen epithelioid granulomas and aggregates of mononuclear inflammatory cells. Some of the sinusoids show congestion, portal tract showed infiltration and marked periportal congestion. Squalene isolated from *Albizia procera* shows normal hepatocytes with sinusoids and portal tract showing recovery. There was no apparent sign of necrosis and periportal infiltration.

## CONCLUSION

Human uses of plants include both practical uses, such as for food, clothing, and medicine, and symbolic uses, such as in art, mythology and literature. The reliable provision of food through agriculture is the basis of civilization and as the feedstock for many industrial products including timber and paper as well as a wide range of chemicals. Plants give millions of people pleasure through gardening. A number of plants have been used in traditional medicine for many years. Traditionally *Albizia procera* have been used for various purposes such as shelter, fodder, fibre, ornamental, timber, gum or resin, fuel, reclamation, nitrogen fixing, and also has therapeutic values against various diseases. Such plants should qualify as medicinal plants On basis of our study, *Albizia procera* is effective against some life threatening diseases and had some well documented biological activities, remaining biological activities were not reported. Some do seem to work although there may not be sufficient scientific data to confirm their efficacy so this article will be helpful for researchers to innovate more pharmacological activities in this plant.

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