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Review Article

Senegalia Catechu

Khadira (Senegalia Catechu) - An Ayurvedic Tree with Great Potential

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Plant based medicine, a cornerstone of traditional healthcare systems, has been utilized for millennia across various cultures to treat a wide spectrum of ailments. Traditional medicine heavily relies on the therapeutic properties of herbs and natural products derived from plants. According to an estimate made by the World Health Organisation (W.H.O.) 80% population of the world relies on traditional medicine and thus it forms the basis of primary healthcare. Primary reason for that being the inexpensive nature of herbal medicines as compared to modern pharmaceutics as these can be grown from seed or gathered from nature for little or no cost. Plants such as Khadira (Senegalia catechu), turmeric and Ashwagandha are some of the prime examples of natural remedies mentioned in Ayurveda classics that have been used for centuries. Khadira (Senegalia catechu) has been revered in Ayurveda for its wide range of therapeutic properties. Khadira commonly known as Kattha or Khair tree, has been extensively used in the management of skin disorders, gastrointestinal ailments and respiratory conditions. The most important bioactive compounds of this plant are flavanoids (catechin, (-) epicatechin, epigallocatechin, epicatechin gallate, epigallocatechin gallate, rocatechin, phloroglucinol, procatechuic acid, catecutannic acid, quercetin, quercitrin), alkaloids (kaempferol, dihydrokaempferol, taxifolin, afzelchin gum), glycosides (poriferasterol, poriferasterol acylglucosides), tannins (gallic acid, phlobatannins), sugars (d-galactose, d-rhamnose and larabinose). It has been shown to possess medicinal properties such as anti-bacterial, anticancer, anti-diarrhoeal, anti-inflammatory, antimicrobial, antioxidant, antipyretic, anti-ulcer, antisecretory, hepatoprotective, hypoglycaemic and useful in sore throat, wound healing and obesity. The present review study aims to comprehensively explore and provide reported detail information of this herb from various Samhitas and its study in modern area like its phytoconstituents, pharmacological activities and therapeutic applications. Focussing on the relevance of Khadira in integrative healthcare approaches, with insights into recent studies will highlight the plant's promising role in drug development and public health.

Keywords: Senegalia catechu, Khair tree, Cutch Tree, Dravyaguna, Ayurveda, EBM

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Introduction

Khadira, scientifically known as *Senegalia catechu*, is a well-regarded tree in traditional *Ayurvedic* medicine, recognized for its potent therapeutic benefits. Native to the Indian subcontinent and parts of Southeast Asia, this deciduous tree has been an integral part of herbal healing practices for centuries. Among its various parts, the heartwood of *Khadira* holds particular medicinal significance due to its rich concentration of bioactive compounds. Traditionally, the heartwood extract has been prized for its strong astringent, antibacterial, and anti-inflammatory properties. These qualities make it especially effective in the treatment of a wide range of health conditions. In *Ayurvedic* formulations, *Khadira* is commonly used to address various skin disorders such as eczema, acne, and rashes, owing to its ability to purify the blood and reduce inflammation. Additionally, it plays a prominent role in promoting oral hygiene, where it is utilized in mouthwashes and tooth powders to help combat gum disease, mouth ulcers, and bad breath.

Beyond dermatological and dental applications, *Khadira* is also used to support digestive health, manage bleeding disorders, and enhance overall immunity. Its diverse therapeutic uses and natural healing potential underscore its importance in holistic and traditional medical systems. As modern research continues to explore the pharmacological actions of *Senegalia catechu*, this ancient remedy remains a vital botanical resource in both preventive and curative healthcare.

Botanical Name: *Senegalia catechu*

Taxonomical Classification

- Kingdom: Plantae;
- Subkingdom: Tracheophyta;
- Superdivision: Spermatophyta;
- Division: Equisetopsida;
- Order: Fabales;
- Family: Fabaceae;
- Genus: *Senegalia*;
- Species: *catechu*

Classical Names

Khadira (Cutch tree), *Balpatra*, *Bahushalya*, *Dantadhawana*, *Raktasara*, *Yadniya*, *Gayatri*.

Vernacular Names

- **English -** Cutch tree;
- **Hindi -** Khair;
- **Bengali -** Khayar;
- **Gujarati -** Kheriobaval, Khair, Kathe, Kher;
- **Kannada -** Kalu, Kachu, Kaggali, Kanti, Kagga-linara, Kachinamara, Koggigida;
- **Malayalam -** Karingali, Khadira;
- **Marathi -** Kaderi, Khair,
- **Punjabi -** Khair,
- **Tamil -** Karunkali, Kadiram, Karngalli;
- **Telugu -** Podalimamu, Kaviri, Kachu, Kadiramu, Sandra,
- **Assam -** Kharira, Khara, Khayar, Khoria, Kash.Kath,
- **Konkani -** Kathu;
- **Oriya** - Khoiru, Khaira,
- **Urdu** - Chanbekaath.**[1]**

Classification In *Ayurvedic* Texts

Khadira included in following *Ganas* (Groups)

- ***Charka Samhita***: *Kushdhghna*, *Kshaya Skan-dha***[2]**
- ***Sushrut Samhita***: *Salsaradi***[3]**

Khadira has been included in *Nighantus* in the following *Vargas* (Groups)

- ***Bhavprakash Nighantu:*** *Vatadi Varga***[4]**
- ***Dhanvantari Nighantu:*** *Guduchyadi Varga***[5]**
- ***Madanpal Nighantu****: Vatadi Varga***[6]**
- ***Aadarsh Nighantu:*** *Babbuladi Varga***[7]**
- ***Kaiyedev Nighantu:*** *Oshadadi Varga***[8]**
- ***Raja Nighantu:*** *Shalmlyadi Varga***[9]**

***Namarupa Vijnana* (Synonyms)**

१.खदिरः (भा०)- खदतिस्थिरंतिष्ठतिहिनस्तिचरोगानीति; 'खद्स्थैर्यहिं-सायांच'।

२.कण्टकी (भा०)- कण्टकाः सन्त्यस्य।

३.कुष्ठघ्नः (अ०)- कुष्ठंहन्तीति।

४.गलरोगनुत (सो०)- गलरोगनाशकः।

५.गायत्री (भा०)- गायन्तंत्रायते, यज्ञेप्रयोज्यत्वात, गलरोगेहितत्वाच्च।

६.जिह्मशल्यः (सो०) - जिह्माःवक्रा: शल्याःकण्टकाऽस्य।

७. दन्तधावनः (भा०)- दन्तधावनेप्रयुक्तत्वात।

८. बहुशल्यः (भा०)- बहवः शल्या: कण्टकाऽस्य।

९. बालपत्रः (भा०)- ह्रस्वपत्रत्वात।

१०. मेदोघ्नः (सो०)– मेदोहर:।

११. यज्ञियः (भा०)- यज्ञेप्रयुज्यमानः।

१२. रक्तसारः (भा०)- रक्तवर्ण: सारोऽस्य।

१३. सारद्रुमः (रा०)- सारवान्वृक्षः।**[10]**

Khadira (Cutch tree) (*Senegalia catechu*) is a wild thorny tree (*Kantaki*, *Bahusalya*), the spines being curved (*Jihmaśalya*). Wood is regarded as holy and used in sacrifices (*Gāyatrī, Yajñiya*). It has firm and red heart-wood (*Sāradruma, Raktasāra*) and small leaves (*Bālapatra*). Twigs are used as tooth-brush (*Dantadhavana*). *Khadira* (Cutch tree) is a specific drug for leprosy (*Kusthaghna*) and is also efficacious in obesity (*Medoghna*) and disorders of throat (*Galaroganut*).

Table 1: Synonyms of *Khadira* (Cutch tree) from various *Nighantus*[11,12,13]

Synonyms	AH	AV	BR	BP	CS	DN	KN	RN	RV	SN	SLN	SS
Balapatra	+	-	-	+	+	+	-	-	-	+	+	-
Brahma Shalya	-	-	-	-	+	-	-	-	-	-	-	-
Bahushalya	-	-	-	+	+	-	+	-	-	-	+	-
Dantadhavana	-	-	-	+	+	+	-	-	-	+	+	-
Dwija Priya	-	-	-	-	+	-	-	-	-	-	-	-
Gayatri	+	-	-	+	+	+	+	-	-	+	+	+
Gita	-	-	-	-	-	-	+	-	-	-	-	-
Gourat	-	-	-	-	-	-	+	-	-	-	-	-
Hima Shalya	-	-	-	-	+	-	-	-	-	-	-	-
Homa	-	-	-	-	+	-	-	-	-	-	-	-
Jihwa Shalya	-	-	-	-	+	+	-	-	-	+	-	-
Khadira (Cutch tree)	+	+	+	+	-	+	-	-	+	+	+	+
Kadara	+	+	-	-	+	-	-	-	+	-	-	+
Kushthaghna	-	-	-	-	-	-	+	-	-	-	-	+
Kantaki	-	-	-	+	+	+	-	-	-	+	+	-
Kushthahrit	-	-	-	-	+	-	-	-	-	-	-	-
Kantari	-	-	-	-	-	-	-	+	-	-	-	-
Kshathaksheeina	-	-	-	-	+	+	+	-	-	+	-	-
Karmuka	-	-	-	-	+	-	-	+	-	-	-	-
Kubjakantaka	-	-	-	-	+	-	-	+	-	-	-	-
Kandu	-	-	-	-	-	-	-	+	-	-	-	-
Kushthakantaka	-	-	-	-	-	-	-	+	-	-	-	-
Kalskanda	-	-	-	-	-	-	-	+	-	-	-	-
Khadiropam	-	-	-	-	-	+	-	-	-	-	-	-

+' indicates present & '–' indicates absent

A.H= *Ashtanga Hridaya*, B.R.= *Bhaishajya Ratnavali*, CS= *Charak Samhita*, RN= *Raj Nighantu*, DN=*Dhanwantari Nighantu*, MN= *Madanpal Nighantu*, KN= *Kaidev Nighantu*, PN= *Priya Nighantu*, SN= *Saligram Nighantu*, SS= *Sharangadhar Samhita*

Figure 1[57]

Ayurvedic Properties

- *Rasa - Tikta, Kashaya*
- *Guna - Laghu, Ruksha*
- *Veerya - Sheeta*
- *Vipaka - Katu*
- *Prabhava - Kushthaghna*
- *Doshaghnata - Kaphapittashamaka*
- *Rogaghnata - Aruchi, Atisara, Kaphajakasa, Prameha, Kushtha, Twakaroga, Jeernajwara, Raktapitta, Krimi.*
- *Karma - Ruchivardhaka, Stambhana, Shonitasthapana, Mutrásangrahana, Kushthaghna, Kandughna, Vranaropaka*

Table 2: *Rasapanchaka* of *Khadira* (Cutch tree) From Various *Nighantus*[11.12,13]

		DN	MN	RN	KN	BH.N	SHA.N	NA	SN	PN
Rasa	Tikta	+	-	+	+	+	+	+	+	+
	Madhura	-	+	-	-	-	-	-	-	-
	Kashaya	-	-	-	-	+	+	+	+	+
Guna	Laghu	-	-	-	-	+	-	-	-	-
Veerya	Sheeta	+	+	+	+	+	-	+	-	+
	Ushna	-	-	-	-	-	+	-	+	-
Vipaka	Katu	-	-	-	-	-	+	+	-	-
Prabhava	Kushthaghna	-	-	-	-	-	-	-	-	+

DN= *Dhanwantari Nighantu*,

MN= *Madanpal Nighantu*, RN= *Raj Nighantu* KN= *Kaidev Nighantu*, N.A= *Nighantu Adarsha*, SN= *Saligram Nighantu*, PN= *Priya Nighantu*

Botanical Description

Senegalia catechu is a medium sized thorny deciduous tree up to 3-15 m high; stem straight and greyish brown, bark dark grey to dark greyish brown, exfoliating in narrow strips brown and red in side.

Leaves are bipinnately compound, with 9-30 pairs of pinnae and a pubescent glandular rachis; leaflets 16-50 pairs, oblong-linear, 2-6 mm long, glabrous or pubescent with a pair of short, hooked shape, recurved prickles or spines at the base of the rachis. Inflorescence cylindrical, axillary pedunculate spike.

Flowers are actinomorphic to zygomorphic, 5-10 cm long, sessile, pentamerous, creamy whitish to pale yellow and with a campanulate calyx of 1-1.5 mm length, and a corolla of 2.5-3 mm length. Stamens are numerous and far exerted from the corolla, with white to yellowish white filaments, bisexual and have single superior carpel; pod is one chambered legume, glabrous oblong, 3-10 seeded, straight, flat and brown in colour with triangular beak at the apex, shiny, narrowed at base.

Heartwood is light, red, turning brownish red to nearly black with age and attached with whitish sapwood. The fracture is hard, odour, characteristic and taste are astringent.

The gummy extract of wood is called *Katha* or *cutch* which is mostly shining black or brownish mass, hard and brittle, and breaks easily. The fractured surfaces show brownish colour but dull gloss and small cavities. It gives dull brown fine odourless powder having strong astringent taste.**[14]**

Distribution

Throughout the Sub-Himalayan tract of Punjab., Peninsular region, particularly in drier parts, Madhya Pradesh, Maharashtra, Gujarat, Bihar, Rajasthan and Tamil Nadu. Also, in Eastern slopes of Western Ghats.**[1]**

Phytochemical Constituents

Heartwood - Flavonoids: Epigallocatechin, epicatechin gallate, Catechin, epicatechin, epigallocatechin gallate, rocatechin, phloroglucinol, procatechuic acid, catecutannic acid, quercetin.**[15]**

Leaves - Alkaloids: Kaempferol, dihydrokaempferol, taxifolin, afzelchin gum.

Bark - Glycosides: Poriferasterol, poriferasterol acylglucosides, Tannins: Gallic acid, d-rhamnose, Sugars: D-galactose, and l-arabinose, phlobatannins.

Fruit - Fruit a strap-shaped pod, 5-8.5 cm x 1-1.5 cm, flat, tapering at both ends, shiny, brown, dehiscent, 3-10 seeded; seeds broadly.**[16]**

Powder - Catechu is used for diarrhoea, swelling of the nose and throat, dysentery, swelling of the colon (colitis), bleeding, indigestion, osteoarthritis, and cancer.**[17]** People apply catechu powder directly to the haemorrhoids and skin diseases and traumatic injuries; to stop bleeding; and for dressing wound. **[18]** It is included in mouthwashes and gargles used for gum disease (gingivitis), pain and swelling inside the mouth (stomatitis).**[19]** It is thought that catechu may contain chemicals that can decrease inflammation and kill bacteria.

Constituents - Catechin, catechu-tannic acid and tannin.

Action and Uses

- The bark is used in melancholia, conjunctivitis and haemoptysis.
- Heartwood is bitter, astringent, acrid, cooling, depurative, anthelmintic, antiseptic, antidysentery, antipyretic, appetiser, haemostatic, anti-inflammatory and tonic. It is used in catarrh, cough, pruritus, leprosy, leukoderma, skin diseases, helminthiasis, anorexia, diarrhoea, dysentery, foul ulcers and wounds, haemoptysis, haematemesis, haemorrhages, fever, anaemia, diabetes and pharyngodynia.
- The catechu (*Kattha*) is acrid, bitter, thermogenic, digestive, appetiser, aphrodisiac, vulnerary, anthelmintic, depurative and tonic. It is used in laryngopathy, flatulence, ulcers, wounds, leprosy, skin diseases, urine incontinence, and colporrhagia. A small piece of catechu with cinnamon and nutmeg is held in toothache, loss of voice etc, also in cases of mercurial salivation, hoarseness, relaxed sore throat, bleeding ulcerations and sponginess of gums. It is used for bed sores.
- Catechu in the form of injection is useful in treatment of gonorrhoea, otitis, otorrhoea.**[20]**

Table 3: Phytochemical Actions

SN	Active constituent	Therapeutic Application
1.	Tannins	Acts topically as astringent to mucosal surfaces and following oral ingestion it consequently gets hydrolysed and alter the fluidity of the bowel contents (so used in anti-diarrheal remedies). They are also attributed with anti-haemorrhagic, anti-inflammatory and antacid properties.
2.	Catechin	Have significant antioxidant and antimicrobial effects. It is considered to be the best antioxidant.[21]
3.	Flavonoids	Increase secretion of insulin and inhibit cyclo-oxygenase and lipoxygenase. Thus, it possesses anti-diabetic and anti-inflammatory effect.[22]
4.	Toxifolin	Potent Antibacterial agent.

Parts Used: Bark, heartwood**[1]**

Dose

- Powder of bark-1-3gm
- Decoction-50-100ml
- Heart wood-0.5-1gm**[1]**

Some Important Preparations[23]

- *Khadiradi Vati*
- *Khadiraristha*
- *Khadiradi Tailam*
- *Erimedadi Taila*
- *Kusthakalamla Rasa*
- *Kusthashailendra Rasa*
- *Krimivinasana Rasa*
- *Arshoghni Vati*
- *Lavangadi Vati*
- *Kasisadi Ghrita*
- *Jatyadi Ghrita*
- *Nimbapatradi Upnaha*

Pharmacological Actions

Antimicrobial Activity: Studies showed that the leaves extract is found to possess broad-spectrum antimicrobial activity, by inhibiting common human pathogenic organisms like *Staphylococcus aureus* (Gram positive), *E-coli, Pseudomonas aeruginosa, Klebsiella pneumoniae*, and *Salmonella typhi* (Gram negative) and fungi like *Candida albicans*, *Aspergillus niger* supporting its use in traditional medicine.

Its leaves, bark, root extract also possess Anti-mycotic activity. The bark extract showed an inhibitory effect on the growth of fungi such as *Piriculariaoryzae* and *Colletotrichum falcatum*.**[24]**

Its Methanolic extract has anti-microbial activity against pathogenic as well as non-pathogenic bacteria. It was found to be most effective against *Staphylococcus aureus* with about 20mm zone of inhibition at minimum bactericidal concentration (MBC) of the crude extract 1,000lg/ml. Experiments shows that anti-microbial activity of Khadira depends on nature of solvent used for extraction, thus organic solvents used in extraction of leaves are most effective than any other.**[25]**

Krimighana* attributes of *Khadira

- *Khadira* exhibits antibacterial and antifungal attributes, effectively impeding the proliferation of bacteria and fungi responsible for skin problems. In case of skin conditions such as eczema, *Khadira* proves beneficial in managing symptoms when applied to the affected area. The application or washing of the affected area with *Khadira Kwath* contributes to reducing inflammation and arresting bleeding, this is attributed to its *Kashaya*, *Ropan* and *Krimighana*
- *Khadira* is also recognized for its ability to facilitate wound healing due to its antibacterial and antifungal attributes. It comprises specific chemicals that induce the contraction of skin cells, diminishing inflammation and fostering the recovery of wounds. Additionally, its antimicrobial properties thwart potential infections, providing support for the healing process. The *Ropan* (healing) attribute of *Khadi*ra contributes to the expeditious recovery of wounds, diminishes swelling, and restores the skin's normal texture. Moreover, *Khadira* plays a role in controlling bleeding from wounds, due to its *Sheeta* and *Kashaya* The *Krimighana* characteristic of *Khadira* prevent reoccurrence and restrict infections thus resist pathological progression of wound.**[26,27,28]**

Antibacterial Activity: *Khadira* heartwood extract is found to be an effective antibacterial agent. A study conducted in ethanolic and aqueous heartwood extract of *Khadira*, proved its efficacy as a potent anti-bacterial agent. *Taxifolin* present in heartwood of *Khadira* is found to be responsible for its antibacterial effect.

Phytochemical studies of *Khadira* leaves show the presence of alkaloids, carbohydrates, flavones, glycosides, phenolic compounds, saponins, steroids and tannins which may be responsible for its antimicrobial activity. Its Methanolic extract having antimicrobial activity against pathogenic as well as non-pathogenic bacteria. It is effective against gram positive as well as gram negative bacteria.**[29]** *Khadira* boasts an extensive antibacterial spectrum, demonstrating bactericidal efficacy against E. coli, S. aureus and S. enterica. Its mechanism of action seems associated with the disruption of bacterial membrane permeability. The principal chemical markers identified in *Khadira* include gallic acid, ellagic acid, eugenol and catechin.**[30,31]**

Antifungal Activity: Ethanolic extract of Heart-wood tested for antifungal (antimycotic) activity against *Candida albicans, Aspergillus Niger, Aspergillus fumigates, Mucor sp* & *Penicilium marneffei*. Disc diffusion technique was followed for screening antifungal activity. Discs were loaded with 50µl of ethanolic extracts at different concentrations [25ug/disc, 250ug/disc and 500ug/disc]. Positive controls used were fluconazole (10 mcg/disc) & amphotericin B (100 units/disc). After incubation at 28ºC for 48 hours, zone of inhibition was measured. Extract at different concentrations showed varying degree of antifungal activity against micro-organisms tested compared to standard.[32] Assay was conducted to check antifungal activity of aqueous & methanol extract of *Khadira* against fourteen human pathogenic fungi using agar disc diffusion method. Methanol extract of *Khadira* was established most promising, & found active against Candida, Dermatophytes & Aspergillus species.**[33]**

Antioxidant Activity: Study of 70% methanol extract of heartwood extract of *S.catechu* showed significant antioxidant activity, iron chelating and DNA protective activity which is partly due to the phenolic and flavonoid compounds present in its Standard methods like the dot-blot assay, TLC study and the DPPH assay showed that the extract is a highly effective antioxidant. Catechin, rutin and isorhamnetin are reported as free radical scavengers and these compounds largely contribute to the biopotency of *Senegalia catechu*.**[34]**

Anti-pyretic and Anti-inflammatory properties: Chief major active chemical components of Khadira are flavonoids which inhibit Cyclooxygenase and 5-Lipoxygenase and hence decrease inflammation. Mixed extract of *Scutellaria baicalensis* and *Acacia catechu* inhibit Prostaglandin E2 generation in human osteosarcoma cells which express COX-2, and leukotriene production is also inhibited in human cell lines, immortalized THP-1 monocyte and HT-29 colorectal adenocarcinoma. Baicalin from *Scutellaria baicalensis* and catechin from *Senegalia catechu* are responsible for dual inhibition of Cyclooxygenase and 5- Lipoxygenase.**[35]** Baicalin and catechin are found to inhibit COX1, COX2 and 5-LOX. Baicalin also downregulates the expression of cytokines and PGE2, nitric oxide formation, and neutrophil invasion in a carrageenan-induced paw edema model.**[36]**

Anti-cancer Activity: Study was conducted to evaluate the cytotoxic effect of aqueous extract of *Khadira* heartwood in a human epithelial carcinoma cell line (A431) and anti-tumour activity against DMBA/TPA induced squamous cell carcinoma in Balb/c mice. It was investigated that chemo preventive effect of aqueous extract of *Senegalia catechu* heartwood maybe was due to its polyphenolic compounds that exhibit powerful antioxidant activity.**[37]** Study was aimed at evaluating the antiproliferative and apoptotic potentials on HeLa, COLO- 205, and fibrosarcoma HT-1080 cell lines and also to evaluate its safety on normal human lymphocytes. Different concentrations of these were evaluated for their cytotoxicity by the trypan blue dye exclusion method and MTT assay on the cancer cell lines HeLa, fibrosarcoma HT-1080, COLO-205, and a normal cell line (human peripheral lymphocytes). The apoptotic potential was analysed by DNA fragmentation analysis, morphology observation, and fluorescence microscopical observations of the treated cells by AO/EB (acridine orange/ethidium bromide) staining. The methanol and hexane extracts of S. catechu were found to be antiproliferative and cytotoxic at lower concentrations and induced cell death in COLO-205 cells and also in HeLa cells. Their effect on HT-1080 fibrosarcoma cells was less pronounced. The methanol and hexane extracts with the same concentrations had least cytotoxicity on normal lymphocytes.**[38]**

Antidiarrheal activity: Antidiarrheal activity was evaluated in albino rats after induc. diarrhoea with castor oil. Antidiarrheal property of ethyl acetate ext. of *Senegalia catechu* appears to be due to its tannin content, which has astringent property.**[34]**

Hepatoprotective activity: Data from traditional medicine history and recent studies shows that extract of *Khadira* exhibits very significant hepatoprotective activity and for this reason it has been extensively used in herbal. Flavonoid constituents of the extract of *Khadira* possess antioxidant properties and are found to be useful in the treatment of liver damage. Hepatoprotective action of heartwood powder was studied in the treatment of liver damage in rats exposed to carbon tetrachloride. The evaluation has been carried out using liver function marker enzymes in blood plasma, Liver tissue biochemistry supported by histopathology due to CCl4 induced hepatopathy the marker enzymes leak into the blood. The extent of recovery has been compared with the natural liver regeneration after CCl4 damage and normal liver. The heartwood powder of *Khadira* has been treated in the form of aqueous slurry. The decreased levels of serum bilirubin after treatment with heartwood powder restores the normal functional status of the liver. This hepatoprotective effect was supported by light microscope studies. Hepatoprotective activity of ethyl acetate extract of *Khadira* was studied in albino rats. Blood serum was assayed for aspartate aminotransferase and alanine aminotransferase and significant increase in the levels of AST and ALT were found in the toxicant group after 24h of administration of carbon tetrachloride orally. Cyanidanol, an active principle of S.catechu, was claimed to be effective in treating liver diseases. **[38,39,40]**

Immunomodulatory Activity:[41]
Immunomodulatory activity of aqueous extract of S. catechu after oral administration of two doses of 5 mg/kg and 50 mg/kg were studied. The effect was studied in neutrophil adhesion test, mice lethality test, carbon clearance assay, cyclophosphamide induced neutropenia, serum immunoglobulin levels and the haemagglutination test. The extract showed an increase in the neutrophil adhesion to the nylon fibres produced a significant increase in the phagocytic index and a significant protection against cyclophosphamide induced neutropenia indicating its effect on cell mediated immunity.

On the other hand, S.catechu extract produced a significant increase in the serum immunoglobulin levels, increase in the haemagglutination titre values and decreased the mortality ratio in mice, suggesting its effect on the humoral arm of the immune system.

Hence, it can be concluded that the aqueous extract of S.catechu has a significant effect on both cell mediated and humoral immunity.

Anti-secretory and Anti-ulcer Activity: Study was conducted on antisecretory and antiulcer activity of Khadira indomethacin plus pyloric ligation induced gastric ulcers in rats. The results of the study suggested that *Khadira* causes an inhibitory effect on release of gastric hydrochloric acids and protects gastric mucosal damage due to presence of flavonoids and tannins in the plant extract.**[42]**

Wound healing: The crushed bark of *Khadira* is used topical on wounds as it is potent wound healing medicinal plant. It has astringent effect and also causes precipitation of skin which makes it very good wound healing plant. Furthermore, it also exhibits antimicrobial property which prevents growth of microbes on wounds. This activity is due to presence of tannins and flavonoids in bark of catechu.**[43]**

Sore throat: *Khadira* is one of most important ingredients, used in *Paan* which is also called as beetle leaf. People of different ages use it for healing of sore throat, because of its astringent and soothing effect. Tannins present in *Khadira* are responsible for this property.**[40]**

Anti-obesity activity: The bark of maintains healthy fat metabolism and reduces the conversion of carbohydrates to fats. In studies of rats fed on a diet containing cholesteryl oleate, betel nut extracts significantly lowered cholesterol & triglycerides.**[44]**

Anti diabetic activity: In type 2 diabetes, insulin is secreted in lesser amounts than required, thus causing much of the sugars to remain in the blood stream. *Khadira* also increases the level of beta cells, thus encouraging them to secrete more insulin. A variety of *Khadira*, known as Blackbrush, is used to help lose body weight. Its adrenergic amine content stimulates beta-receptors to break down the lipids in the body. This, in turn, enhances the rate of metabolism as cholesterol is broken down and hunger is curbed.**[45]**

Mode of Action of *Khadira* in *Prameha*

Prameha is defined in classics as the *Kaphavata* predominant disease. Even though all three *Dosha* are involved in the *Prameha* manifestation, the *Vata* predominance is understood with hypo functioning of *Agni* (*Mand*) or *Vishamagni*.**[46]**

This improper *Agni* influence *Kapha* and *Aam* production into body. Further, due to unwholesome diet and regimen (*Apathyaaharavihara*) *Kapha, Mamsa, Meda* gets aggravated and cause obstruction (*Margavarodha*). *Khadira* with *Kashaya rasa* clears channels due to *Kaphashoshan* (Absorption of *Kapha*) as well as decreases *Kleda*. *Katuvipaka* helps to increases digestion. Thus, it stimulates *Jatharagni* and regularizes *Mandagni* which is main cause of *Prameha*. *Laghu* and *Ruksha Guna* clears *Mala, Kleda* from *Strotas* and alleviates. So, *Khadira* is capable of correcting *Dhatuvitiatison* (*Saithilyata*). Due to *Kashaya Rasa*, *sheet Veerya* and *Ruksha Guna*, it acts as *Sthambhaka* hence performs *Mutrasangrahaniya Karma* i.e., Reduces amount of *Mutra* thus restore normal *Ambu*. *Khadira* has '*Tikta*' *Rasa* in addition to *Kashayarasa*. *Tiktarasa* has predominance of *Akasha* and *Vayumahabhoota*. So, it has ability of permeate to *Sukshmasrotasas*. Due to this drug can reach at cellular level and help to reduce *Meda* and *Kleda*. Thus, helps in breakdown of *Pramehasamprapti* and reduces related symptoms.**[47]** Many times, diabetes existed along with obesity and diabetic wound. Properties of *Khadira* like *Pramehaghna* (Anti-diabetic), *Mehaghna* (Anti-obesity) and *Vrana-Ropan* (wound healing) properties are well explained in *Ayurvedic* classics.

Relation between chemical compositions and *Prameha*

- **Flavonoids:** It is an 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.**[48]** Also, Flavonoids stimulated glycogen synthesis in rat's soleus muscle through mechanisms well known to insulin signal transduction.**[49]**
- **Saponins:** Saponins have been found having pharmaceutical properties of anti- inflammatory, anti- fungal, anti-bacterial, antiviral and anti-diabetes. In the aspect of anti-diabetes, saponins activates AMPK in a calcium-dependent manner, thus regulating gluconeogenesis and glucose uptake. Saponins effectively alleviated hyperglycaemia in diabetic rats by upregulating the expression of glucose transporter type 4(GLUT4) while down- regulated the expression of G6P in insulin signal pathway.**[50]**
- **Triterpenoids:** The therapeutic approach of Triterpenoids to treating DM is to decrease postprandial glucose levels. It can be achieved through the inhibition of α- glucosides and α-amylases which delay the absorbance of carbohydrates in postprandial insulin level.**[51]**
- **Bitter principle:** Compound stimulate peripheral and skeletal muscle glucose utilization and inhibits intestinal glucose uptake and shows hypoglycaemic effect.**[52]**

Effect in *Shwitra* (Vitiligo): A clinical trial with *Bakuchi Haratal Lepa* with *Gomutra* as external application and *Amalaki Khadir Kashyam* orally was done. It has shown encouraging results in the re-pigmentation of the affected skin. Not much complication was observed in the patients at the end of the study.**[53]**

Effect in Acne vulgaris: *Khadira* honey contains a large concentration of fructose sugar; hence it does not crystallize. This honey possesses antimicrobial properties to a great extent. Hence, it is used in conjunction with other medication as a remedy for abating the acne flare-ups in teenagers. The naturally occurring sugars or oligosaccharides in *Khadira* contain a greater portion of the food energy of sugar and a lesser portion of the food energy of fat. In the body, they result in fatty acids that enhance the absorption of calcium, magnesium, and iron. Thus, they promote an overall raise in energy levels in the body**.[45]**

Effect in Intestinal Problems: Acacia contains water soluble fibre of plant origin. Fiber is an important requisite to provide roughage and smooth bowel movements of the intestines. Thus, enhances the colon cleanse process in the body. The effectiveness of *Khadira* is felt more when it relieves the symptoms of irritable bowel syndrome in a natural way.

The soluble fibre in *Khadira* absorbs excess water from the colon and forms a thick gel. This passes through the gut without any decomposition. Hence, it adds a good extent of bulk to the stools and aids in their easy elimination. By regulating the speed of bowel movements, it helps in relieving the bloating and trapped gas in the digestive canal. It also promotes the development of bifidobacteria and lactic acid bacteria, which are healthy bacteria in the gut. Thus, relieves constipation and promotes greater health to the alimentary canal.**[45]**

Effect in Oral Diseases: *Khadira* contains *Tikta-Kashaya Rasa*. These two *Rasa* by virtue of their pharmacological properties like *Soshana* (absorption), *Vishaghnatva* (anti-poisonous), *Kandu Prashamana* (reduce itching sensation), *Tvakmamsa Sthirikarana* (nourishment and strengthening of skin and muscle) and *Pidana*, *Ropana* (wound healing), *Kledaupashosana* (dryness of exudation) causes therapeutic action of reducing oedema, detoxification, restoration, antihistaminic action and contraction, healing, clearing of derbies. All these pharmacological properties as a whole are able to exert an anti-inflammatory action on affected areas of skin, mucosal and muscle layer of buccal region which is beneficial to cure dental caries, gum infections, complication of buccal mucosa. In disease condition of buccal cavity, *Khadira* is used as important medicine to get rid of it. In infective pathology of dental caries or periodontal disease, *Khadira* completely inhibits pathway of pathogenesis of infection by creating an unfavourable condition in *Dosha-Dushya-Sammurchana* (destroy causative pathological factors). *Khadira* is most potent drug to cure all types of such infections.**[54]**

Khadira as best *Rasayana* (Immunomodulator) for skin

Khadir (S. catechu) is having *Tikta*, *Kashaya Rasa*, *Sita Virya* which alleviates *Pitta Kapha*. *Acharya Charaka* mentioned it as best *Kustahara Dravya* in *Agryaprakarana*. It has also properties of *Switraghna*. *Kandugna*, *Krimihara*. The decoction has important ingredients like *catecnin* (flavonoid), *catechu tannic acid*. There by *Khadira* helps for better absorption. *Kashaya Rasa* of *Khadira* holds *Twakprasadak* and *Raktashodhak* properties which ultimately leads to *Raktaprasadana* and reduction of *Vaivarnyata* of skin, thus proved to be best immunomodulatory drug for skin diseases.**[55]**

Table 4: Pharmacological activity of various parts of *Senegalia catechu*.[56]

SN	Parts Used	Pharmacological activity
1.	Bark	Dysentery, diarrhoea and in healing of wounds, Antioxidant, healing of sore throat, gingivitis, Antidiabetic activity.
2.	Leaf	Hepatoprotective, Anti-secretory and Anti-ulcer, Antioxidant and Antibacterial, Anti-mycotic activity.
3.	Heartwood	Anti-bacterial, Anti mycotic, to treat mouth sore, gingivitis, dental caries It possess anti-oxidant and anti-diarrhoeal activity. Ethyl acetate extract of Acacia catechu possess analgesic, antipyretic Hepatoprotective and Antidiabetic activity. Heartwood is used as a dyeing agent in textile industry.

Conclusion

For centuries, plants and plant products have been used for treating various ailments. Several medicinal trees and their products are still widely used by the traditional medical practitioners for curing various diseases in their day-to-day practice. *Khadira* (*Senegalia catechu)* is a multifunctional drug, which is mostly used in Skin disorders. It possesses broad spectrum pharmacological activities in various systems to cure diseases.

The review on *Khadira* (Cutch tree) traces out from the *Samhitas* to modern literature text and researches. It has many medicinal properties, which can be used to cure or helps to reduce many ailments like Skin disorders, diabetes, obesity, worm manifestation, liver disorders, ulcers, fever, oral diseases, gastro-intestinal diseases, etc. Due to *Tikta Kashaya Rasa*, *Katuvipaka*, it shows *Kaphashoshan* property (Absorption of *Kapha*), clears the channels by reducing obstructions, and improves the hypo functioning of *Agni*. Due to *Tikta Rasa Khadira* shows *Aampachan, Angnideepana* and *Srotoshodhana* properties. Main chemical constituents of *Khadira* are Flavonoids, Tannins, Saponins, Alkaloids, Glycosides which shows anti-diabetic activity.

Khadira has been shown to possess multifarious medicinal properties such as Antioxidant, Anti-hyperlipidaemic, Anti-diabetic, Anti-obesity, Wound healing property, Analgesic activity, Antifungal activity, Anti-inflammation activities. *Khadira* also screened for effective in diabetes associated with obesity and diabetic wound. *Khadir*a is one of the best examples to prove potent as a skin immunomodulator. Acharya Sushruta has beautifully explained its role in various skin ailments, *Khadirarishta* as best potent drug of choice for skin and *Khadiradi Vati* used in *Shushka Kasa*.

Thus, *Khadira* [*Senegalia catechu*] is considered as a potent medicinal plant, a gift from Ayurveda to mankind**.**

References

1. Sharma PV. Namrupajnanam: Characterization of medicinal plants based on etymological derivation of names and synonyms. Varanasi: Chaukhambha Visvabharati; p. 159. *[Crossref][PubMed][Google Scholar]*

2. Borke CA, Stevens GR, Garriqan MJ. Locomotor effects in sheep of alkaloids identified in Australian Tribulus terrestris. Aust Vet J. 1992;69:163–5. *[Crossref][PubMed][Google Scholar]*

3. Sastri K. Charaka Samhita. Varanasi: Chaukhambha Bharti Academy; Reprint 2013. . *[Crossref][PubMed][Google Scholar]*

4. Shastri A. Sushruta Samhita Sutra 38. 12 (Ayurveda Tatva Sandipka). Varanasi: Chaukhambha Sanskrit Sansthan; 2009. *[Crossref][PubMed][Google Scholar]*

5. Pandey GS. Bhavaprakash Nighantu. Varanasi: Chaukhambha Bharti Academy; 2013. . *[Crossref][PubMed][Google Scholar]*

6. Sharma PS, Sharma G. Dhanvantari Nighantu (Hindi translation). 2nd ed. Varanasi: Chaukhambha Orientalia; 1998. *[Crossref][PubMed][Google Scholar]*

7. Sharma PV. Kaidev Nighantu. 1st ed. Varanasi: Chowkhamba Orientalia; 1979. *[Crossref][PubMed][Google Scholar]*

8. Vaidya GI. Nighantu Adarsha. 1st ed. Varanasi: Chowkhamba Vidyabhavan; 1968. *[Crossref][PubMed][Google Scholar]*

9. Narahari P. Raj Nighantu. Tripathi I, editor. Varanasi: Krishna Das Academy; 1st ed. *[Crossref][PubMed][Google Scholar]*

10. Sharma PC, Yelme MB, Dennis TJ. Database on medicinal plants used in Ayurveda. Vol. 3. *New Delhi: Central Council for Research in Ayurveda & Siddha; 2005 [Crossref][PubMed][Google Scholar]*

11. Gupta A, editor. Astanga Hridaya of Vagbhatta. 13th ed. Varanasi: Chaukhambha Sanskrit Sansthan; 2000. *[Crossref][PubMed][Google Scholar]*

12. Sharma V, Sharma GP. Dhanvantari Nighantu. Varanasi: Chaukhambha Orientalia; 2008. p. *121–2 [Crossref][PubMed][Google Scholar]*

13. Chunekar KC. Bhavaprakash Nighantu. Varanasi: Chaukhambha Bharati Academy; Reprint 2018. p. *518 [Crossref][PubMed][Google Scholar]*

14. Pandey G. Madanpal Nighantu. Varanasi: Chaukhambha Orientalia; 2012. p. *193 [Crossref][PubMed][Google Scholar]*

15. Roy A, Geetha RV, Lakshmi T. In vitro evaluation of anti-mycotic activity of heartwood extract of Acacia catechu Willd. J Pharm Res. 2011;4(7):2010–11. *[Crossref][PubMed][Google Scholar]*

16. Gayathri DV, Lanitha J, Devi R, Sreekala, Prabhakaran VA. Pharmacognostical studies on Acacia catechu Willd and identification of antioxidant principles. Int J Pharm Pharm Sci. 2011;3(2):108–11. *[Crossref][PubMed][Google Scholar]*

17. Varkung V, Imoba TS, Joychandra SO, Babycha L, Aruna S. Protective effect of ethyl acetate extract of Acacia catechu in carbon tetrachloride-induced hepatotoxicity. Indian Med Gaz. 2012;:159–62. *[Crossref][PubMed][Google Scholar]*

18. Guleria S, Tiku A, Singh G, Vyas D, Bhardwaj A. Antioxidant activity and protective effect against plasmid DNA strand scission of leaf, bark, and heartwood extracts from Acacia catechu. J Food Sci. 2011;76(7):C959–64. *[Crossref][PubMed][Google Scholar]*

19. Seigler DS, Ebinger JE. Cyanogenic glycosides in ant-acacias of Mexico and Central America. Southwest Nat. 1987;32(4):499–503. *[Crossref][PubMed][Google Scholar]*

20. Narayana A. Khadira (Cutch tree) (Acacia catechu Linn.)—a medico-historical review. PubMed. *PMID:11619395 [Crossref][PubMed][Google Scholar]*

21. Naik GH, Priyadarshani KI, Satv JG, Banvalikar MM, Sohoni DP, Biyani MK. Comparative antioxidant activity of individual herbal components used in Ayurvedic medicine. Radiation Chemistry and Chemical Division, BARC, Trombay, Mumbai; 2002. . *[Crossref][PubMed][Google Scholar]*

22. Noreen S, et al. Planta Med. 1998;64:United States. . *[Crossref][PubMed][Google Scholar]*

23. Sharma PV. Dravyaguna Vijnana. Vol. 2. *Reprint ed. Varanasi: Chaukhambha Academy; 2011. p.370 [Crossref][PubMed][Google Scholar]*

24. Hashmat MA, Hussain R. A review on Acacia catechu Willd. Interdiscip J Contemp Res Bus. 2013;5(1):May. *[Crossref][PubMed][Google Scholar]*

25. Lakshmi T, Geetha RV, Roy A. In vitro evaluation of antibacterial activity of heartwood extract of Acacia catechu Willd. Int J Pharm Bio Sci. 2011;2(2):B188. *[Crossref][PubMed][Google Scholar]*

26. Kumar AS, Lakshmi T, Arun AV. In vitro antibacterial activity of Acacia catechu ethanolic leaf extract against selected acidogenic oral bacteria. Res J Pharm Technol. 2012;5(3):333–6. *[Crossref] [PubMed][Google Scholar]*

27. Chaudhari SK, Tripathi S, Singh DP, et al. An overview on Acacia catechu. Int J Res Rev Pharm Appl Sci. 2012;2(2):342–6. *[Crossref][PubMed] [Google Scholar]*

28. Tangeti S, Gabbita P, Ponnaluri RR, et al. Comparative study of the wound healing effect of topical Acacia catechu extract and silver sulfadiazine on excisional wound model in guinea pigs. Int J Basic Clin Pharmacol. 2018;7(12):2347–52. *[Crossref][PubMed][Google Scholar]*

29. Gayathri DV, Lanitha J, Devi R, Sreekala, Prabhakaran VA. Pharmacognostical studies on Acacia catechu Willd and identification of antioxidant principles. Int J Pharm Pharm Sci. 2011;3(2):108–11. *[Crossref][PubMed][Google Scholar]*

30. Acharya JT, editor. Charaka Samhita of Agnivesha, Sutra Sthana. Reprint ed. Varanasi: Chaukhambha Prakashan; 2011. *Ch.30, Ver.15. p.162 [Crossref][PubMed][Google Scholar]*

31. Sharma A, editor. Sushruta Samhita with Sushrutvimarshini Hindi commentary. Varanasi: Chaukhambha Surbharati Prakashan; Nidansthan, Ch. 16, Ver. *13. p.573 [Crossref][PubMed][Google Scholar]*

32. Roy A, Geetha RV, Lakshmi T. In vitro evaluation of anti-mycotic activity of heartwood extract of Acacia catechu Willd. J Pharm Res. 2011;4(7):2010–11. *[Crossref][PubMed][Google Scholar]*

33. TG N, Sarang S, Jambhale D. Evaluation of anti-mycotic activity of Acacia catechu Willd (Mimosaceae). J Biopestic. 2008;1(2):197–8. *[Crossref][PubMed][Google Scholar]*

34. Satpudke S, Pansare T, Khandekar S. Review on Khadira (Cutch tree) with special reference to Prameha (Diabetes). Int J Herbal Med. 2020. *[Crossref][PubMed][Google Scholar]*

35. Altavilla D, Squadrito F, Bitto A, Polito F, Burnett B, Di Stefano V, Minutoli L. Flavocoxid blunts proinflammatory phenotype activation in endotoxin-stimulated macrophages. Br J Pharmacol. 2009;157(8):1410–8. *[Crossref][PubMed][Google Scholar]*

36. Burnett B, Jia Q, Zhao Y, Levy R. A medicinal extract of Scutellaria baicalensis and Acacia catechu acts as a dual inhibitor of COX and 5-LOX. J Med Food. 2007;10(3):442–51. *[Crossref][PubMed] [Google Scholar]*

37. Jitender M, Chetan CS, Manu S. Human epithelial carcinoma cytotoxicity and inhibition of DMBA/TPA-induced squamous cell carcinoma in Balb/c mice by Acacia catechu Willd heartwood. J Pharm Pharmacol. 2011;63:1470–82. *[Crossref] [PubMed][Google Scholar]*

38. Nadumane KV, Nair S. Evaluation of anticancer and cytotoxic potentials of Acacia catechu extracts in vitro. J Nat Pharm. 2011;2(4):190–5. *[Crossref] [PubMed][Google Scholar]*

39. Ray D, Sharatchandra K, Thokchom I. Antipyretic, antidiarrhoeal, hypoglycaemic and hepatoprotective activities of ethyl acetate extract of Acacia catechu Willd in albino rats. Indian J Pharmacol. 2006;38(6):408–13. *[Crossref] [PubMed][Google Scholar]*

40. Atmani D, Chaher N, Berboucha M, Debbache N, Boudaoud H. Flavonoids in human health: from structure to biological activity. Curr Nutr Food Sci. 2009;5(4):225–37. *[Crossref][PubMed][Google Scholar]*

41. Ismail S, Asad M. Immunomodulatory activity of Acacia catechu. Indian J Physiol Pharmacol. 2009;53(1). *[Crossref][PubMed][Google Scholar]*

42. Karwani G, Singhvi I, Gupta S, Kapadiya N, Sisodia SS. Antisecretory and antiulcer activity of Acacia catechu Willd against indomethacin plus pyloric ligation-induced gastric ulcers in rats. J Cell Tissue Res. 2011;11(1):2567–71. *[Crossref] [PubMed][Google Scholar]*

43. Alam G, Singh MP, Singh A. Wound healing potential of some medicinal plants. Int J Pharm Sci Res. 2011;9(1):136–45. *[Crossref][PubMed][Google Scholar]*

44. Hashmat MA. A review on Acacia catechu Willd. Interdiscip J Contemp Res Bus. 2015;1:593–9. *[Crossref][PubMed][Google Scholar]*

45. Acacia and health. Available from: [Diet Health Club – Acacia Herb Profile](https://www. diethealthclub. com/herbs-andnatural-cures/acacia. *html) [Crossref][PubMed][Google Scholar]*

46. Joshi VMS. Ayurvediya Shabdhakosha. Mumbai: Rajya Sahitya Sanskriti Mandal; 1968. p. *123 [Crossref][PubMed][Google Scholar]*

47. Cooke T. Flora of the Presidency of Bombay. Vol II. Varanasi: Chaukhambha Bharati Publication; 1902. *p.541 [Crossref][PubMed][Google Scholar]*

48. Mohan S, Nandhakumar L. Role of various flavonoids: Hypothesis on novel approach to treat diabetes. Iran J Med Hypoth Ideas. 2014;8(1):1–6. *[Crossref][PubMed][Google Scholar]*

49. Cazarolli LH. Stimulatory effect of apigenin-6-C-β-L-fucopyranoside on insulin secretion and glycogen synthesis. Eur J Med Chem. 2009;44(11):4668–73. *[Crossref][PubMed][Google Scholar]*

50. Lu JM. Antidiabetic effect of total saponins from Polygonatum kingianum in streptozotocin-induced diabetic rats. J Ethnopharmacol. 2015;9(17):291–300. *[Crossref][PubMed][Google Scholar]*

51. Nazaruk J. The role of triterpenes in the management of diabetes mellitus and its complications. Phytochem Rev. 2015;14(4):675–90. *[Crossref][PubMed][Google Scholar]*

52. Ming-junchen. Phytochemicals for non-insulin diabetes mellitus: A minireview on plant-derived compounds with hypoglycemic activity. J Food Nutr Sci. 2017;5(2):23–7. *[Crossref][PubMed][Google Scholar]*

53. Mandloi A, Dash B. A clinical evaluation of Bakuchi Hartal Lepa and Amalaki Khadir Kashayam in the management of Switra (Vitiligo) – A pilot study. J Ayurveda Integr Med Sci. 2023;9:40–5. *[Crossref][PubMed][Google Scholar]*

54. Mishra VP, et al. Antimicrobial activities of Acacia catechu (Khadira) with respect to oral disease – A review. Int J Med Health Sci. 2020;6(2):15–24. *[Crossref][PubMed][Google Scholar]*

55. Meshram VS, et al. A review on Khadir (Acacia catechu) as best Rasayana (immune-modulator) for skin. World J Adv Health Res. 2020;6(8):65–8. *[Crossref][PubMed][Google Scholar]*

56. Lakshmi T, et al. In vitro antibacterial and pharmacological activity of Acacia catechu Willd. Int J Drug Dev Res. 2011;3:328–34. *[Crossref] [PubMed][Google Scholar]*

57. Twig with flowers – Acacia catechu (Mimosaceae). Available from: [iStock Acacia Catechu Image](https://www. istockphoto. com/photo/twig-with-flowers-acacia-catechu-family). *[Crossref][PubMed][Google Scholar]*