ejpmr, 2019,6(1), 216-223

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

PHYTOPHARMACOLOGY OF *ACACIA CATECHU* WILLD: A REVIEW

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Article Received on 03/11/2018 **Article Revised on 23/11/2018** **Article Accepted on 13/12/2018**

ABSTRACT

Khadir (Acacia catechu Willd) beloning *to* Family-Fabaceae and subfamily-Mimosoideae has a great importance due to its medicinal properties and is commonly known as Katha. It is a historical plant; widely used in traditional medicine especially in Asia. In *charka Samhita*, *vimansthan* chapter 8 *Khadira* (*Acacia catechu* Willd) included in *kashay skandha. Kashay rasa* plays an important role in *kledashoshan* (Absorbing *Kleda*). *Dhatushaithilyanashan* (destroys *Dhatushaithilyanashan*) beside this *kashay rasa* has *vranropan* (wound healing) property. *Khadir (Acacia catechu* Willd) possess predominant *kashay rasa*, *sheet veerya* and *katu vipak*. The useful part of *Khadira* is bark. The main chemical constituents of Black catechu 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 multifarious medicinal properties such anti-bacterial, anticancer, anti-diarrhoeal, anti-inflammatory, antimicrobial, antioxidant, antipyretic, anti-ulcer, antisecretory, hepatoprotective, hypoglycaemic, sore throat and wound healing and anti-obesity etc. The article deals with the importance of *Acacia catechu* willd in maintaining human health. This rivew give detail information regarding *Acacia catechu* willd. The present review article provides up-to-date information on the medicinal properties of the plant.

KEYWORDS: Acacia catechu willd, Phytoconstituents, Medicinal properties.

INTRODUCTION

Khadir (Acacia catechu Willd) is a historical plant has a valuable importance because of its medicinal properties**.** In Ayurveda its many synonyms has been mentioned like *balapatra* (tini leaved) *vakrakanta* (due to hooked spines), *dantadhavana* (useful for cleansing the teeth), *kanthi* (beneficial for throat), *kusthaghna* (anti dermatosis) etc.[1] In *sanskrit Khadira* means that which alleviates stabilizes the body and the diseases. The great *Susruta* has described the plant to be effective as an antiobesity herb.[2] *Acacia catechu* Willd. (Family: Fabaceae and subfamily: Mimosoideae.) is widely used in Ayurveda for mainly for skin diseases. *Khadira* water (karingali water) is used as a drinking water in kerla.[3] The species name comes from 'cutch', a tanning extract isolated from its heartwood. *Acacia catechu* Willd is a small or medium-sized, thorny tree up to 15 m tall; bark dark grey or greyish-brown, peeling off in long strips, or sometimes in narrow rectangular plates, brown or red inside; branches slender, puberlous when young but glabrascent, with 2 curved, 8-mm prickles at the base of each petiole.[4] It is widely used in *Ayurveda* for processing of various formulations. There are many *ayurvedic* preparations like *khaditatishta*, *Khadiradi gutika*, *Irimedadi taila* etc. which contain *Khadira* as main active ingredients. *Acacia catechu* willd also known as *Katha* which is a dispensable ingredient of pan (betel leaf preparation) chewed in *India* and *pakistan.*[5] It is useful in oral, throat infections and dental.[6] *Acacia catechu* exhibits various pharmacological effects like anti-inflammatory, anti-diarrhoeal, hypoglycemic, antioxidant, hepatoprotective, antipyretic, and anti-microbial activities anti-bacterial, anticancer**,** anti-ulcer, antisecretory**,** hepatoprotective**,** hypoglycaemic**,** sore throat and wound healing etc. The main chemical constituents of Black catechu 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). *Acacia catechu* is also useful as a topical agent for sore gums and mouth ulcers.[7] Thus the plant has diverse pharmacological actions. Therefore, the aim of this study is to evaluate its various pharmacological activities which can be safely used for various ailments. However, future studies are needed to prove its efficacy in clinical trials.

Ayurvedic Aspect
Khadira included in following gana (Groups)
1. Charka samhita: *Kushdhghna, Kashayscantha.*[8]
2. Sushrut samhita: *Salsaradi.*[9]
***Khadira* has** been included in ***Nighantus* in the following Vargas (Groups)**
Bhavprakash nighantu: *Vatadi Varga.*[10]
Dhanvantari nighantu: *Guduchyadi varga.*[11]
Madanpal nighantu: *Vatadi varga.*[12]
Aadarsh nighantu: *Babbuladi varga.*[13]
Kaiyedev nighantu*: Oshadadi varga.*[14]
Raja nighantu: *Shalmlyadi varga.*[15]

Synonyms[3]
Balapatra- tini leaved
Vakrakanta- hooked spines.
Dantadhavana- cleansing the teeth.
Gayatri-strengthens the throat of singer
Kantaki- having thorns
Bahushalya-having many thorns(spines)
Yadnyiya- one of the ingradient needed for performing yadnya (religious ritual)
Raktasara-possesses red heartwood

Common Name of *Acacia catechu* Willd in Different Language[16]
Gujarati- Khair, Kathe, Kher
Bengali- Khera, Khayera
Hindi - Khair
Kannada- Kachinamara, Kaggali, Kaggalinara
Kashmiri- Kath
Assamese- Kharira, Khara, Khayar
Malayalam- Karingali
Marathi- Kharira, Khair
Oriya- Khaira
Punjabi- Khair
Tamil- Karungkali, Karungali
Telugu- Chandra, Kaviri Urdu Chanbe, Kaath
Sanskrit- Khadira, Raktasaar

Types[10]
Shweta Khadira (*Acacia suma* Buch-Ham)
Durgandha Khadira / Arimeda (*Acacia farnesiana* Willd)
Bilayati babul (*Acacia leucophloea* Willd)

Raspanchaka of *Khadira*[17]
Rasa: Tikta, Kashaya
Guna: Laghu, Ruksha
Virya: Shita
Vipaka: Katu
Prabhav- *Kushdhaghana* (Useful in skin diseases).

Karma- *Krumighna* (to kill warms*), Kushaghna* (Useful in skin diseases) कुष्ठे-खदिरस्य सार:।[8]**,** *Medohara* (anti-obesity*), Raktashodhaka* (Useful as blood purifier), *Kaphapittahara* (alleviates kapha and pitta dosha), *Dantya* (beneficial for teeth).

Doshghnata- *Kaphapittshamak* (alleviates kapha and pitta dosha).

Therapeutic uses- *Shothahara* (cures inflammation), *Kushtha* (cures skin disease), *Prameha* (useful in Diabetes), *Vrana* (useful in wound).

Upyuktanga (part used)- Bark, katha[29]
Habitat
It is obtain in Myanmar, Nepal, Pakistan, Thailand Indonesia, Kenya, Mozambique, China, and India, in India it is found in Madhya Pradesh, South, and Indian Ocean *Acacia catechu* Willd is Angiosperm widely distributed throughout the central Asia especially Pakistan, India and Bangladesh.[18]

General uses
It is an extract of its heartwood,[19] is used as an ingredient to give red color and typical flavor to paan. Paan, from the word in Hindi is an Indian and Southeast Asian tradition of chewing betel leaf (Piper betle) with areca nut and slaked lime paste.

The tree is often planted for use as firewood and charcoal and its wood is highly valued for furniture and tools. The wood has a density of about 0.88 g/cm^3.

Uses of *Khadira* heartwood extract is used in as a preservative for fishing nets, dyeing and leather tanning, and as a viscosity regulator for oil drilling.[20]

Seeds of *Acacia catechu* Willd are very good source of protein. Its extract is used in paan (chewing betel leaf) which is used after meal as sweet dish or along with tobacco for stimulant effect. Paan is a part of tradition of indo Asian culture. Leaves and branches are also food of goats and other animals.

Wood of *Khadira* (*Acacia catechu* Willd) is very good firewood so people also use it for fire purposes. Its wood is not only good for burning fire but also have a very high place in furniture manufacturing.

Uses of Khadira according to various Samhita

Sr.no	Samhita	Useful in diseases
1.	*Charak samhita*[8]	*Vatajkasa* (Dry cough), *Krumikushtha* (useful in skin diseases),*raktapitta* (Urticaria), *vranashodhan*(useful in wound)
2.	*Sushrut samhita*[9]	*Shodrameha* (beneficial in diabetes), *shnairmeha, Kushtha* (diabetes).
3.	*Vagbhata*[21]	*Mukharoga* (useful in mouth disease)
4.	*Harita samhita*[8]	*Dantaroga* (beneficial for teeth). , *sthavarvish prativish* (useful in poisoning)
5.	*Chakradatta*	*Swarbheda* (useful in horseness of voice*), visfota (*beneficial for skin disease)
6.	*Shodhal*	*Shleepada* (useful in filariasis)
7.	*Vrunda*	*Kushte rasayan, twagdosha* (useful for skin)

Important formulations - *Khadirarishta, Arimedadi Taila, Khadiradi Gutik, Khadiradi Kwatha*
Dose - Decoction of the drug -30-50 ml.
Salchurna-1-1.5gm
Katha-0.5-0.75 gm

Modern Aspect of *Khadira*
Taxonomical classification[22]
Kingdom -Plantae – Plants
Sub kingdom Tracheobionta – Vascular plants
Spermatophyta- Seed plants
Division Magnoliophyta - Flowering plants
Class Magnoliopsida - Dicotyledons
Subclass- Rosidae
Order- Fabales
Family Fabaceae - Pea family
Genus Acacia Mill. – Acacia
Species Acacia catechu Willd. – black cutch

Plant description[23]
Plant is of small to moderate size of about 15m hight.

Leaves- *Acacia catechu* leaves are bipinnately compound, with 9-30 pairs of pinnae and a glandular rachis.

Leaflets- Present in many pairs i.e 16-50 pairs, oblong-linear, 2-6 mm long, glabrous or pubescent.

Flowers- 5-10 cm long (auxiliary spikes, pentamerous), white 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.

Bark- is dark grey or grayish-brown.

Botanical description[24]
Khadira (*Acacia catechu* Willd) is also known as black catechu. Word acacia came from Greek word "Throns" meaning "point or a barb". The species name is derived from word "cutch" which is a tanning extract obtained from heartwood of *Khadira*.

Khadira (*Acacia catechu* Willd) belongs to family "Fabaceae" and sub family is "Mimosoideae" while order is "Fabales".

Phytochemicals
Heartwood- Flavanoids- Epigallocatechin, epicatechin gallate, Catechin, (-) epicatechin, epigallocatechin gallate, rocatechin, phloroglucinol, procatechuic acid, catecutannic acid, quercetin.[25]

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.[26]

Powder- Catechu is used for diarrhea, swelling of the nose and throat, dysentery, swelling of the colon (colitis), bleeding, indigestion, osteoarthritis, and cancer.[27] People apply catechu powder directly to the hemorrhoids and skin diseases and traumatic injuries; to stop bleeding; and fordressing wound.[28] It is included in mouthwashes and gargles used for gum disease (gingivitis), pain and swelling inside the mouth (stomatitis),[29] It is thought that catechu may contain chemicals that can decrease inflammation and kill bacteria.

Constituents - Catechin, catechu-tannic acid and tannin.

Pharmacognostical studies[30]
a) Macroscopic
Heart-wood, light red, turning brownish-red to nearly black with age, attached with whitish sapwood, fracture hard, taste, astringent.

b) Microscopic
Transverse section of heart-wood shows, numerous, uni- to bi-seriate medullary rays, vessels occurring isolated or in small groups of two to four, xylem fibres with narrow lumen occupying major portion of wood, xylem parenchyma usually predominantly paratracheal, forming a sheath around vessels, wood consists of crystal fibres with 14-28 segments, each having one prismatic crystal of calcium oxalate, a few tracheids with scalariform thickening, some of cells, including vessels, filled with brown content, prismatic crystals of calcium oxalate present in a number of cells throughout the wood.

Powder- Brown coloured, under microscope shows a number of xylem fibres, vessels, crystal fibres, and prismatic crystals of calcium exalate.

Identity, purity and strength
Foreign matter Not more than 2 per cent, Appendix 2.2.2.

Total Ash Not more than 2 per cent, Appendix 2.2.3.

Acid-insoluble ash Not more than 1.2 per cent, Appendix 2.2.4.

Alcohol-soluble extractive Not less than 1 per cent, Appendix 2.2.6.

Water-soluble extractive Not less than 3 per cent, Appendix 2.2.7.

Medicinal uses[31]
The most common use of *Khadira* (*Acacia catechu* Willd) is in sore throat. It is very old and very effective remedy. It provides astringent and soothing effect to throat. Tannins present in *Acacia catechu* are very useful in tanning (precipitation of skin) so burns and wounds are treated with extract of bark. It is very traditional method used for acute and chronic wound healing. Bark of *Khadira* contain alkaloids and many other very potent active components which shows anti-microbial activity so for management of wounds and burns it also acts as a disinfectant which reduces the chances of infections at the site of wound. Due to presence of alkaloids and other active constituents it is used in many dermatological disorders. A combination of cinnamon and extract of *Khadira* is given to treat diarrhea. *Khadira* is also used as anti-pyretic and anti-inflammatory as it inhibits COX1 and COX2. Its anti-pyretic and anti-inflammatory property is not only confined to in vivo studies but it is practically used in folk medicines. Biologically active major components have antioxidant property.

Pharmacological activities
Antibacterial Activity
Khadira (*Acacia catechu* Willd) 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. In vitro, *Acacia catechu* Willd is reported to have broad spectrum antimicrobial and antifungal activity. Phytochemical studies of *Khadira* leaves shows 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 nonpathogenic bacteria e.g. Bacillus subtilis, Staphylococcus aureus, Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa and Candida albicans. It is effective against gram positive as well as gram negative bacteria.[32]

Antifungal Activity
Ethanolic extract of Heartwood of *Acacia catechu* Willd was tested for antifungal (antimycotic) activity against Candida albicans, Aspergillus Niger, Aspergillus fumigates, Mucor spp and Penicilium marneffei. Disc diffusion technique was followed for screening antifungal activity. The 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) and amphotericin B (100 units/disc). After incubation at 28^{o}C for 48 hours, the zone of inhibition was measured. The extract at different concentrations showed varying degree of antifungal activity against the micro organisms tested compared to standard.[33] Assay was conducted to check antifungal activity of the aqueous and methanol extract of *Acacia catechu* Willd against fourteen human pathogenic fungi using agar disc diffusion method. The methanol extract of *Acacia catechu* Willd was established most promising, and found active against Candida, Dermatophytes and Aspergillus species therefore stressing the need to locate the active principle.[34]

Anti-microbial activity
In vitro *Khadira* (*Acacia catechu* Willd) is reported to have broad spectrum anti-microbial and antifungal activity. Phytochemical studies of *Acacia catechu* Willd leaves shows the presence of alkaloids, carbohydrates, flavones, glycosides, phenolic compounds, saponins, steroids and tannins which may be responsible for its anti-microbial activity.

Its Methanolic extract of has Anti-microbial activity against pathogenic as well as nonpathogenic bacteria e.g Bacillus subtilis, Staphylococcus aureus, Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa and Candida albicans. It is effective against gram positive as well as gram negative 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 1,000 lg/ml. Experiments shows that anti-microbial activity of *Khadira* (*Acacia catechu* Willd) depends on nature of solvent used for extraction, thus organic solvents used in extraction of leaves are most effective than any other.[35]

Anti-oxidant Activity
As the *Khadira* (*Acacia catechu* Willd) contain many potent flavonoids such as catechin present in this plant plays a vital role as anti-oxidant. Catechins and rutin are most important constituents which are free radical scavengers. Antioxidant principles of *Acacia catechu* Willd were analysed by Dot-blot assay & quantitative analysis by DPPH radical scavenging assay with ascorbic acid as standard.[36,37]

Anti-cancer Activity

Study was conducted to evaluate the cytotoxic effect of aqueous extract of *Khadira* (*Acacia catechu* Willd) 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 chemopreventive effect of aqueous extract of *Acacia catechu* Willd heartwood maybe was due to its polyphenolic compounds that exhibit powerful antioxidant activity.[38] Study was aimed at evaluating the antiproliferative and apoptotic potentials of *Acacia catechu* Willd 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, fi brosarcoma HT-1080, COLO-205, and a normal cell line (human peripheral lymphocytes). The apoptotic potential was analyzed 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 A. *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. The aqueous extract was less effective on the cancer cell lines.[39]

Antidiarrhoeal Activity

Ethyl acetate extract of *Khadira* (*Acacia catechu* Willd) was evaluated for antidiarrhoeal property in castor oil induced model of diarrhoea in albino rats. *Khadira* (*Acacia catechu* Willd) at a doses of 250 mg/kg, p.o., (single doses) has been found to posses highly significant antipyretic activity ($P<0.01$) in respect of latent period of onset of diarrhoea, average number of stool passed and purging index.[40]

Hepato protective activity

Data from traditional medicine history and recent studies shows that extract of *Acacia catechu* Willd exhibits very significant hepato protective activity and for this reason it has been extensively used in herbal. Flavonoid constituents of the extract of *Acacia catechu* willd possess antioxidant properties and are found to be useful in the treatment of liver damage. Hepatoprotective action of heartwood powder of *Acacia catechu* willd 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* (*Acacia catechu* Willd) has been treated in the form of aqueous slurry. The decreased levels of serum bilirubin after treatment with heartwood powder of *Acacia catechu* willd 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 24 h of administration of carbon tetrachloride orally. Cyanidanol, an active principle of *Acacia catechu* Willd, was claimed to be effective in treating liver diseases.[41-43]

Anti pyretic and Anti-inflammatory properties

The chief major active chemical components of *Khadira* (*Acacia catechu* Willd) 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 *Acacia catechu* Willd are responsible for dual inhibition of Cyclooxygenase and 5-Lipoxygenase.[44] 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.[45]

Sore throat

Khadira (*Acacia catechu* Willd) is one of most important ingredient 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 *Acacia catechu* Willd are responsible for this property. This is very common in Asia especially in central Asian countries like Pakistan and India and most common home remedy used for sore throat.[43]

Anti-secretory and Anti-ulcer Activity

Study was conducted on antisecretory and antiulcer activity of *Khadira* (*Acacia catechu* Willd) against indomethacin plus pyloric ligation induced gastric ulcers in rats. The results of the study suggested that *Khadira(Acacia catechu* Willd) causes an inhibitory effect on release of gastric hydrochloric acids and protects gastric mucosal damage due to presence of flavanoids and tannins in the plant extract.[46]

Hypoglycaemic Activity

In eastern traditional medicine *Acacia catechu* Willd is extensively used in management of diabetes in combinations with other medicinal plants. Polar as well as non-polar components of *Acacia catechu* Willd shown hypoglycaemic activity. Hypoglycemic activity of extract of *Khadira* (*Acacia catechu* Willd) is assumed to be due to the presence of flavonoids which also show

inhibition of cyclooxygenase and regenerate β cells. In an experiment, ethyl acetate extract of *Acacia catechu* Willd at a concentration of 500mg/kg/day used for 7 days, significantly decreases blood glucose level of normal as well as alloxan induced diabetic albino rats but it was not effective as that of standard drug. Studies show that myricetin, quercetin and catechin-gallate inhibit insulin stimulated glucose transporters in cells.[40,47]

Immunomodulatory Activity

Immunomodulatory activity of aqueous extract of *Acacia catechu* Willd after oral administration (5 mg/kg and 50 mg/kg). The effect was studied in neutrophil adhesion test, mice lethality test, carbon clearance assay, cyclophosphamide induced neutropenia, serum immunoglobulin levels and the heamagglutination test. *Acacia catechu* Willd 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.[48]

Wound healing

In Asia crushed bark of *Acacia catechu* Willd is used topical on wounds as it is potent wound healing medicinal plant. It has astringent effect and also cause 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 flavanoids in bark of *Acacia catechu* willd.[49]

Miscellaneous uses

Used in India as an ointment for indolent ulcers and has been used in rural Bangladesh as a component of an anti-fertility pill, arresting nose bleeds, chronic gonorrhea can be treated with an infusion of catechu.[50] It is also used in skin disorders, itching problems, obesity, blood disorders, asthma, anemia, dental caries, vaginal diseases, leucorrhea, menorrhagia, sexual dysfunction, and helminthiasis and in hypertension.[51] Decoction of bark mixed with milk is taken to cure cold and cough. Decoction is taken as tea by the pregnant ladies to keep warm their body.[52]

Manufacturing process of kathha

Heart wood of *khadira* or acacia is cut into fine chips and around 8-10 kgs. of chips are kept in wire net cage to avoid direct contact with heated surface of extractor. These cages with about 28-29 ltrs of water (3 times the weight of chips) are placed in extractors. Extraction is done by boiling chips with water for about 3.5 hours.[52] Extracts from each extractor are mixed after filtering with the help of fine muslin cloth and concentrated in an open pan on fire and then kept in shade to facilitate crystallization of *Kattha* for about 48 hours. After complete crystallization, the curd like mass is passed through frame and plate-type filter press, operated manually and then it is washed with cold water which improves the quality of kattha.[53] It is then placed on wooden frames provided with canvas cloth to separate traces of cutch. Finally, kattha is cut into uniform tablets with the help of wire cutter or knife and dried in sheds. The mother liquor after removal of kattha is further concentrated in an open pan till it becomes viscous and then poured in wooden frames for drying.[54] The dried material is cutch. About 100 kgs of acacia chips give 5 kgs. of kattha and 14 kgs of cutch. Yield largely depends upon the quality of chips.

Anti-obesity activity

The bark of *Acacia catechu* Willd family Fabaceae, 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 and triglycerides.[55]

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. Due to its Tikta Kashay rasa sheeta Virya and katu Vipaka it shows *Kushdhaghana* (Useful in skin diseases) *Medohara* (anti-obesity), *Raktashodhaka* (Useful as blood purifier), *Kaphapittahara* (alleviates kapha and pitta dosha), *Dantya* (beneficial for teeth) property. The main chemical constituents of *Acacia catechu* Willd flavanoids, alkaloids, sugars, glycosides, tannins. *Khadiar* has been shown to possess multifarious medicinal properties such as anti-bacterial, anticancer, anti-diarrhoeal, and antiinflammatory, antioxidant, hepatoprotective, hypoglycaemic, sore throat and wound healing etc. The present review article provides up-to-date information on the medicinal properties and phytochemical constituents of *Acacia catechu* Willd. We hope this review article will help the scientists working in the area of traditional medicines and medicinal food in their future endeavour.

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