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“ACACIA CATECHU WILLD –A GIFT FROM AYURVEDA TO MANKIND” –A REVIEW

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ABSTRACT

The medicinal plants are widely used by the traditional medical practitioners for curing various diseases in their day to day practice. *Acacia catechu willd* (AC).(Family: Fabaceae and subfamily: Mimosoideae) known as Black cutch has a diverse pharmacological actions and has been widely used in Ayurveda for processing of various formulations in Rasashastra.The main chemical constituents of Acacia Catechu are catechin, epecatechin, epigallocatechin, epicatechin gallate, phloroglucin, protocatechuic acid, quarcetin, poriferasterol glucosides, lupenone, procyanidin, kaemferol,L-arabinose, D-galactose.D-rhamnose andaldobiuronic acid, afzelchin gum, mineral and taxifolin. Heartwood is used to yield concentrated aqueous extract i.e. Cutch and Katha. The cutch and Katha (extract) possess astringent, cooling and digestive properties; and is commonly used in ayurvedic preparations. It is useful in cold and cough, ulcers, boils and eruptions of the skin, bleeding piles, uterine haemorrhages, atonic dyspepsia, chronic bronchitis etc. Based upon the scientific literatures, the aim of this article is to compile and explore the potency of *Acacia catechu willd* in management of various diseases.

Keywords: *Acacia catechu willd*, Ayurveda, catechin, tannins, flavonoids, taxifolin

INTRODUCTION

Ayurvedic medicine also known as Ayurveda, originated in India several thousand years ago. The term "Ayurveda" combines the Sanskrit words ayur (life) and Veda (science or knowledge) thus; Ayurveda means "the science of life."^[1] The botanical name of khadira is *Acacia catechu*. The Sanskrit word Khadira literally means that which alleviates the diseases and stabilizes the body. Khadira has various synonyms in ancient scriptures of Ayurveda, like balapatra tini leaved; vakrakanta has hooked spines, dantadhavana useful for cleansing the teeth, kanthi beneficial for the throat, kusthaghna anti dermatosis, etc. The great sage Charaka has categorized it as udarka prasamana anti urticarial and kusthaghna anti dermatosis. Acharya Vagbhata has highly praised it as the drug of choice for the treatment of numerous skin diseases. Susruta has described the plant to be effective as an anti obesity herb. *Acacia catechu* Willd. (Family: Fabaceae and subfamily: Mimosoideae.) is widely used in Ayurveda for many diseases and mainly for skin diseases.^[2] Most of the people in Kerala use boiled Khadira water (karingali water) for drinking purpose. There are a number of ayurvedic taila (oil) formulations which contain Khadira as one of the active ingredients^[3]. *Acacia catechu* is highly valuable for its powerful astringent and antioxidant activities. It is commonly

known as Katha which is an indispensable ingredient of Pan that is betal leaf preparation chewed in India. It is useful in dental, oral, throat infections and as an astringent for reducing oozing from chronic ulcers and wounds. The concentrated aqueous extract known as Khair gum or cutch is an astringent, cooling and digestive, beneficial in cough and diarrhea. Applied externally to ulcer, boils and skin eruptions and is used extensively in Ayurvedic formulations^[4]. It is used in the treatment of passive diarrhea either alone or in combination with cinnamon or opium.^[5]

The bark of *Acacia catechu* in combination with other drugs is prescribed for snake bite^[5]. The seeds of the plant are reported to possess hypoglycemic activity in rats^[6]. *Acacia catechu* also shows hypotensive effect.^[7] The decoction of bark mixed with milk is taken to cure cold and cough^[8-12]

The extracts of *Acacia catechu* exhibits various pharmacological effects like antipyretic, anti-inflammatory, anti-diarrhoeal, hypoglycemic, hepatoprotective, antioxidant and antimicrobial activities.^[8, 10-14] Main chemical constituents of *Acacia catechu* Willd are catechin, (-) epicatechin, epigallocatechin, epicatechin gallate, epigallocatechin galleate, rocatechin,

phloroglucin, protocatechuic acid, quercetin, poriferasterol glucosides, poriferasterol acylglucosides, lupenone, lupeol, procyanidin AC, kaempferol, dihydrokaemferol, taxifolin, (+)-afzelchin gum and mineral .^[10,15-20] The chief phytoconstituent of the heartwood are catechin and epicatechin. Catechins have significant antioxidant and antimicrobial effects.^[21] It is considered to be the best antioxidant. The antioxidant activities are evaluated in terms of ascorbate equivalents by different methods. The extract restores antioxidant enzyme superoxide (SOD) from the radiation inducing damage.

Acacia catechu is useful as a topical agent for sore gums and mouth ulcers.

This agent has been commonly used in India as an ointment for indolent ulcers and has been used in rural Bangladesh as a component of an anti-fertility pill. Other uses include arresting nose bleeds, assisting healing in nipple fissures, and acting as a contraceptive. Chronic gonorrhoea can be treated with an infusion of catechu.^[22]

Hence, the aim of the present article is to review the pharmacological activity of the herbal plant and compile the literature based upon its efficacy in management of various diseases.

Table 1: Scientific classification of *Acacia catechu willd.*

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	<i>Acacia</i> Mill. – <i>Acacia</i>
Species	<i>Acacia catechu</i> (L. f.) Willd. – black cutch



Fig 1: *Acacia catechu willd*, Medicinal plant



Fig 2: *Acacia catechu* Heartwood.

Plant Description ^[23]

It is a medium sized, thorny deciduous tree grows up to 13 meters in height. Leaves are bipinnately compound, leaflets 30-50 paired, main rachis pubescent, with large conspicuous gland near the middle of the rachis. Flowers are pale yellow, sessile, found in axillary spikes. Fruits show flat brown pods, with triangular beak at the apex, shiny, narrowed at base. There are 3-10 seeds per pod. The gummy extract of the wood is called katha or cutch.

Synonyms

Sanskrit : Gayatri

Assamese : Kharira, Khara, Khayar

Bengali : Khera, Khayera

English : Black catechu, Cutch tree

Gujrati : Khair, Kathe, Kher

Hindi : Khair

Kannada : Kaggali, Kaggalinara, Kachinamara, Koggigida

Kashmiri : Kath

Malayalam : Karingali

Marathi : Khaira, Khair

Oriya : Khaira

Punjabi : Khair

Tamil : Karungali, Karungkali

Telugu : Chandra, Kaviri

Urdu : Chanbe Kaath

Ecology and distribution ^[24]

History of cultivation

The use of *A. catechu* as tanning agent (cutch) in India is believed to go back as far as history relates. In 17th century, a European writer first described *A. catechu* as 'cacho' and mentioned it as being exported from Cambay to Malacca. By the early 19th century, due to commercial importance, catechu was much used in France. The first *A. catechu* to reach European countries had been re-exported from Japan and was called 'terra japonica', being thought at that time to be a natural earth or of mineral origin.

Natural Habitat

A. catechu occurs naturally in mixed deciduous forests and Savannas of lower mountains and hills. It is especially common in the drier regions on sandy soils of riverbanks and watersheds.

Geographic Distribution ^[25]

Native: India, Myanmar, Nepal, Pakistan, Thailand

Exotic: Indonesia, Kenya, Mozambique.

Part used: Bark, Leaves, Heartwood

Ayurvedic Properties of Heartwood and Action ^[26]

Rasa (taste): Tikta, Kasaya

Guna (property): Laghu, Ruksa

Virya (potency) : sita

Vipaka (post digestive effect): Katu
Karma: Kaphapittahara, Raktasodhaka,
Kushtaghna, Medohara, Krmighna, Dantya.

Important Formulations:

Khadirarista, Arimedadi Taila, Khadiradi
Gutika.

Therapeutic Uses:

Kustha, Vrana, sotha, Prameha

Use of *Acacia catechu* in Ayurvedic literature ^[26]

Acacia catechu is used in skin disorders, itching problems, diseases of teeth, diseases of mouth and throat, cough, obesity, worms, diabetes, fever, vitiligo, swelling, wound, bleeding disorders, anemia, eruptive boils, filaria and is used as rasayana (longevity enhancer).

In Chinese medicine it is used for poorly healing ulcers, weeping skin diseases, oral ulcers, with bleeding and traumatic injuries.

Table 2: Phytochemical Action of *Acacia catechu* willd.

Active constituent	Therapeutic application
Tannins	Acts topically as astringent to mucosal surfaces and following oral ingestion it consequently get hydrolyzed and alter the fluidity of the bowel contents (so used in anti-diarrheal remedies). They are also attributed with anti-hemorrhagic, anti-inflammatory and antacid properties.
Catechin	Have significant antioxidant and antimicrobial effects. It is considered to be the best antioxidant ^[27]
Flavonoids	Increase secretion of insulin and inhibit cyclooxygenase and lipoxygenase. Thus it possesses anti diabetic and anti-inflammatory effect. ^[28]
Taxifolin	Potent Antibacterial agent.

Functional uses of *Acacia catechu*: ^[29]

Food: Seeds contain water-soluble mucilage (6.8%); a good protein source ^[30] It is also used as an ingredient in paan. It is an Indian and South East Asian tradition of chewing

betel leaf (Piper betle) with areca nut and slaked lime paste.

Fodder: Branches of the tree are quite often cut for goat fodder and are fed to cattle

Fuel: The tree is often planted for use as firewood and its wood is highly valued for furniture and tools.

Timber: Timber is used for agricultural implements and wheels. Spent chips left over after extraction of Katha and cutch can be used for the manufacture of hardboards.

Tannin or dyestuff: Cutch, which is marketed as a solid extract, is isolated from the heartwood. The dark catechu or Pegu cutch is used to tan heavy hides into sole leather, often in a mixture of tan stuffs. Catechu extract is also used for dyeing silk, cotton, canvas, paper and leather to a dark-brownish colour. ^[31]

Gum or resin: The bark exudes a light gum of very good quality and is one of the best substitutes for gum arabic.

Medicinal value: Khersal, a crystalline form of cutch sometimes found deposited in cavities of the wood is used medicinally for the treatment of coughs and sore throat. The bark is said to be effective against dysentery, diarrhoea and in healing of wounds. The seeds have been reported to have an antibacterial action. ^[32]

Pharmacological activity:

Estimation of catechin in Ayurvedic oil formulations containing *Acacia catechu*:

A sensitive, simple, rapid and efficient HPTLC method was developed and validated for the

analysis of catechin in Ayurvedic oil formulations containing *Acacia catechu*. Chromatography of methanolic-0.1% formic acid (7:3, v/v) extracts of these formulations was performed on silica gel 60 F254 aluminium-backed TLC plates of 0.2 mm layer thickness. The plate was developed up to 85 mm with the ternary-mobile phase chloroform-acetone-0.1% formic acid (7.7 + 1.5 + 0.8%, v/v/v) at 22 +/- 2 degrees C with 20 min of chamber saturation. The system produced compact spots of catechin at an Rf value of 0.36. The marker, catechin, was quantified at its maximum absorbance of 296 nm. The limit of detection and quantitation values was 6 and 20 ng/spot, respectively. The linear regression analysis data for the calibration plot showed a good linear relationship with a correlation coefficient of 0.9993 in the concentration range of 200-1200 ng/spot for catechin with respect to peak area. Repeatability of the method was 0.88% RSD. Recovery values from 97 to 102% indicate excellent accuracy of the method. ^[33]

Anti-bacterial activity:

Acacia catechu heartwood extract is found to be an effective antibacterial agent. A study conducted in ethanolic and aqueous heartwood extract of *Acacia catechu*, proved its efficacy as a potent anti-bacterial agent. Taxifolin present in heartwood of *Acacia*

catechu is found to be responsible for its Anti-bacterial effect.^[34]

Similar study was conducted to evaluate the potency of *Acacia catechu* heartwood extract against dental caries causing microbes and organism associated with endodontic infections like *streptococcus mutans*, *streptococcus salivarius*, *Lactobacillus acidophilus* and *Enterococcus faecalis* using disc diffusion method^[35] *Streptococcus mutans* and *Lactobacillus acidophilus* are potent initiator for dental caries that results in destruction of mineralised tissues in the teeth . Hence our study shows that *Acacia catechu* heartwood extract is highly active on oral pathogens and can be applied in Dental practice in the field of periodontal diseases like dental caries, gingivitis, mouth sores and in Endodontal treatment as *Enterococcus faecalis* is found to be the root cause of failure in root canal treatment^[36].

In a Study Pawar et -al explained a dentifrice / herbal tooth powder which was comprised of *Acacia catechu*, Menthol and camphor in the proportion 91%, 2.7% and 6.3% respectively. The powder of *Acacia catechu* was used to remove tarter, plaque, stain and in cleansing and polishing tooth surface without producing any abrasion whereas menthol and camphor were used as

flavouring agents. A clinical study on this herbal dentifrice , reported 87-95%, 70-72% and 80-95% reductions in plaque, gingivitis and dental calculus respectively, in about 15 days of treatment^[37].

Katha, a resin part of *Acacia catechu Willd*, is used as a chewing ingredient. The Antimicrobial screening and phytochemical analysis were performed to prove the antibacterial property and presence of active phytochemicals in extracts of *Acacia catechu*. A phytochemical analysis was done using a HPTLC instrument. Antimicrobial testing demonstrated excellent results with the petroleum ether extract against *Pseudomonas aeruginosa* (10 µg/mL), followed by the aqueous extract against *Bacillus subtilis* (20 µg/mL) and the chloroform extract against *Staphylococcus aureus* (30 µg/mL). Two major phytochemical constituents, epicatechin and quercetin, were identified by HPTLC as active ingredients in the extract^[38]

Gulzar et al also has conducted a similar study on Preliminary phytochemical and antimicrobial activity of the crude extract obtained from the leaves of *Acacia catechu* (AC.).The presence of carbohydrates, steroids, alkaloids, glycosides, tannins, saponins, flavones and phenolic compounds was indicated by the tests conducted.

Antimicrobial activity of petroleum ether, ethanolic and ethanol: water (1:1) extracts of leaves of *Acacia catechu* was evaluated against some pathogenic fungi and gram positive and negative bacteria. Ethanolic extract was found to possess the broadest and potent antimicrobial activity.^[39]

Anti mycotic activity:

A study was conducted to evaluate the anti mycotic activity of heartwood of *Acacia catechu* Willd on selected fungal species like *Candida albicans*, *Aspergillus niger*, *Aspergillus fumigates*, *Mucor spp* and *Penicillium marneffeii*. Disc diffusion technique was followed for screening anti-fungal activity. The results obtained from our study shows that ethanolic extract has got a very good anti mycotic activity against the selected fungal species.^[40]

An attempt was made to assess the antimycotic activity of *Acacia catechu* Willd. extracts using three different solvents such as ethanol, acetone and hexane. Agar well diffusion technique was followed for screening against chosen fungi like *Aspergillus niger*, *Fusarium oxysporum*, *Alternaria alternata*, *Rhizopus stolonifer* and *Macrophoma phaseolina*. The maximum inhibition was recorded in ethanol, acetone and hexane roots extracts. *A. niger* growth was controlled by acetone extract of bark,

whereas *F. oxysporum*, *A. alternata*, *R. stolonifer* and *M. phaseolina* by acetone extracts of *A. catechu* extract. These extracts can be utilized for the management of this plant. It is recommended to isolate, identify and integrate the bioactive principle in these pathogens management.^[41]

The antifungal activity of the aqueous and methanol extract of twenty Indian medicinal plants against fourteen human pathogenic fungi. Antifungal assay was done using agar disc diffusion method. The result showed that the aqueous extract of *Andrographis paniculata* was only found active while the methanol extract of seven plants i.e. *Acacia catechu*, *Hemidesmus indicus*, *Andrographis paniculata*, *Pongamia pinnata*, *Carica papaya*, *Cannabis sativa* and the *Oroxylum indicum* exhibited significant antifungal activity against one or more test organism. The methanol extract of *Acacia catechu* was established most promising, and found active against *Candida*, *Dermatophytes* and *Aspergillus species* therefore stressing the need to locate the active principle.^[42]

Anti-oxidant activity:

Gayathri devi et al conducted a .pharmacognostical study on *Acacia catechu willd* and the antioxidant principles were analysed by Dot-blot assay and quantitative analysis by DPPH (1, 1, - diphenyl-2-picryl

hydrazyl) radical scavenging assay with ascorbic acid as standard. The results of dot-blot assay showed yellow coloured spots when sprayed with DPPH solution the plant extract proves to be antioxidant. When the plates were sprayed with DPPH solution in methanol (0.4mM), the regions where substances with antioxidant capacity occurred stained yellow in the purple background. The TLC of the alcoholic plant extract conducted using CEF (chloroform-ethyl acetate -formic acid, 5:4:1) as mobile phase and DPPH as spray reagent, gave six major spots with yellow colour indicating that there are at least six antioxidant constituents in the extract. The more intense the yellow colour, the greater the antioxidant activity. Radical scavenging activity was estimated by DPPH assay and the results were compared with that of ascorbic acid. Ascorbic acid at 66.12 μ M could scavenge half of DPPH (IC₅₀) when reacted for 30 minutes. IC₅₀ value of the plant extract was found to be 61.72 μ M which is comparable with the values obtained for ascorbic acid.^[43]

Similar study was carried out to determine the antioxidant and iron chelating property of 70% methanolic extract of 'katha' (heartwood extract of *Acacia catechu*). The extract was found to be an antioxidant with a TEAC value of 0.72 \pm 0.02. The extract has shown its scavenging activity for different

radical and 17.8 \pm 0.63 μ g/ml, 39.55 \pm 1.36 μ g/ml, 55.31 \pm 7.12 μ g/ml, 746.85 \pm 30.46 μ g/ml, 44.2 \pm 4.48 mg/ml, 57.5 \pm 4.23 μ g/ml, 155.48 \pm 3.78 μ g/ml were determined as IC₅₀ value for DPPH, superoxide, nitric oxide, peroxy nitrite, hydrogen peroxide, singlet oxygen and hypochlorous acid radicals, respectively. The plant was found to inhibit lipid peroxidation with an IC₅₀ of 12.35 \pm 0.43 μ g/ml. The extract also has the ability to chelate iron with an IC₅₀ of 810.8 \pm 20.74 μ g/ml as well as DNA protective property with [P]50 of 60.44 \pm 5.73 μ g/ml. It was also observed that the plant extract (100 mg) has 97.13 \pm 0.006 mg/ml gallic acid equivalent phenolic and 383.66 \pm 0.014 mg/ml quercetin equivalent flavonoid content. In a word, the results provide evidence that 70% methanol extract of 'katha' acts as an antioxidant, iron chelator and DNA protector which is partly due to the phenolic and flavonoid compounds present in it.^[44]

Four aqueous extracts from different parts of medicinal plants used in Ayurveda (an ancient Indian Medicine) viz., *Momardica charantia* Linn (AP1), *Glycyrrhiza glabra* (AP2), *Acacia catechu* (AP3), and *Terminalia chebula* (AP4) were examined by **Naik G.H et al** for their potential as antioxidants. The antioxidant activity of these extracts was tested by studying the inhibition of radiation induced lipid peroxidation in rat liver

microsomes at different doses in the range of 100-600 Gy as estimated by thiobarbituric acid reactive substances (TBARS).^[45] The extracts were found to restore antioxidant enzyme superoxide dismutase (SOD) from the radiation induced damage. The antioxidant capacities were also evaluated in terms of ascorbate equivalents by different methods such as cyclic voltametry, decay of ABTS(-) radical by pulse radiolysis and decrease in the absorbance of DPPH radicals.^[15]

Patil.S conducted a free radical scavenging study on Aqueous extracts of *Acacia catechu* and *Rotula Aquatica*. His study revealed that the polyphenols present in the polar extracts possess a stronger antioxidant activity which may be useful in treatment of cancer and in cancer patients undergoing radiation therapy.^[46]

Immuno modulatory activity:

Syed Ismail and Mohammed Asad has studied the Immuno modulatory activity of aqueous extract of *Acacia catechu* after oral administration of two doses of 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 haemagglutination test. *Acacia catechu*

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, *Acacia 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 *Acacia catechu* has a significant effect on both cell mediated and humoral immunity.^[47]

Anti-pyretic activity^[48]

To prove the effect of *Acacia catechu* in yeast induced pyretic rats Ray et al conducted a study in Albino rats (150-200 g) after inducing fever by injecting, subcutaneously, 20% suspension of dried yeast in 2% gum acacia in normal saline at a dose of 20 ml/kg of body weight. Animals in the various groups were treated as Group A: 3% aqueous suspension of *gum acacia* (1 ml/200 g) as vehicle, orally. Group B: Aqueous suspension of ethyl acetate extract of *Acacia catechu* 250 mg/kg (1 ml/200 g) with 3% gum acacia as 5% suspension, orally. Group C: Aqueous suspension of ethyl acetate extract of *Acacia catechu* 500 mg/kg

(1 ml/200 g) with 3% gum acacia as 10% suspension, orally. Group D: Aqueous acetyl salicylic acid, 300 mg/kg (1 ml/200 g) with 3% gum acacia as 6% suspension, orally. Rectal temperature was recorded every hour for four hours after administration of drugs. The ethyl acetate extract of *Acacia catechu* and aspirin significantly decreased the temperature of pyretic rats at 2nd, 3rd and 4th hour after drug or extract treatment.

Hepato protective activity^[48]

Cyanidanol, an active principle of *Acacia catechu*, is claimed to be effective in treating liver diseases^[49]. Jayasekhar et al studied the hepatoprotective activity of ethyl acetate extract of *Acacia catechu* in albino rats^[50]. Blood serum was assayed aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were assayed using a method reported by Reitman and Frankel. Significant increase in the levels of AST and ALT were found in the toxicant group ($P < 0.001$) after 24 h of administration of CCl₄ orally. Pretreatment with *Acacia catechu* (250 mg/kg) and silymarin (25 mg/kg) in test group and standard group, respectively, daily for seven days showed highly significant ($P < 0.001$) protective effect against CCl₄ induced hepatotoxicity when compared to toxicant alone group. There was no significant difference ($P < 0.5$) between the

protective ability of the test drug and the standard drug silymarin, when compared.

Shirish S. Pingale also investigated the hepatoprotective action of *Acacia catechu* heartwood extract on CCl₄ (Carbon tetra Chloride) induced liver damage in rats. Blood and tissue biochemical assays have been studied for evaluation of hepatoprotection. From the results of the parameters done it is clear that *Acacia catechu* gave best recovery for hepatoprotection^[51]

Anti-Diarrhoeal activity^[48]

Fifty albino rats were screened initially by administering 1 ml of castor oil orally and those which developed diarrhoea were selected (consistency, i.e. loose stool, was the criterion for selection). The experimental set-up was as follows. Group A (Control): received 3% aqueous gum acacia suspension 1 ml/200 g, p.o., at '0' hour and castor oil 1 ml/150 g, p.o., one hour later. Group B (Test): received ethyl acetate extract of *Acacia catechu* 250 mg/kg as 5% suspension in 3% gum acacia in DW (1 ml/200 g, p.o.) at '0' hour and castor oil 1 ml/150 g, p.o., one hour later. Group C (Standard): received diphenoxylate 10 mg/kg (0.2%) with atropine sulphate (0.002%) suspension in 3% *gum acacia* in distilled

water at a dose of 1ml/ 200 g, p.o. and castor oil 1ml/150 g, p.o, one hour later.

The extract of *Acacia catechu* (250 mg/kg) markedly reduced the percentage of animals that had diarrhoea (50%). The latent period (5.25 ± 0.31) was prolonged and average number of stool passed was significantly reduced (0.7 ± 0.26), leading to very low purging index (16.28) compared to the control group. Both the standard and test drugs brought a highly significant ($P < 0.001$) change in the latent period of onset of passing stool as well as in total number of stools passed.

Enteric bacteria comprised of *Salmonella sp.*, *Shigella sp.*, *Proteus sp.*, *Klebsiella sp.*, *E. coli*, *Pseudomonas sp.*, *Vibrio cholerae*, and *S. aureus*, which are major etiologic agents of sporadic and epidemic diarrhoea both in children and in adults.^[52]

A study was conducted to evaluate the anti-bacterial activity of heartwood extract of *Acacia catechu willd* on selected enteric pathogens. Antibacterial activity of ethanolic and aqueous extract of heart wood of *Acacia catechu* was screened against *Salmonella typhi*, [Gram negative bacilli-GNB], *Shigella flexneri*[GNB], *E.coli*[GNB], *Klebsiella pneumoniae*[GNB], *Vibrio cholerae*[GNB], *Pseudomonas*

aeruginosa[GNB] and *Staphylococcus aureus*,[Gram positive cocci], using agar well diffusion technique. The results of this study showed that both the extracts at different concentrations exhibited anti-bacterial activity against the bacterial species tested.^[53] Hence, *Acacia catechu* heartwood extract is also proven to be an effective medicinal plant to treat diarrhoea caused by enteric pathogens.

Anti-diabetic activity :

In India, a number of plants are mentioned in ancient literature (Ayurveda) for the cure of diabetic conditions. *Acacia catechu Willd* (Cutch tree) is commonly used by many traditional healers in most of the herbal preparations for diabetes.^[54]

Only the aqueous extract of barks of this plant is used in traditional herbal preparations. Moreover, researchers focus mainly on ethanolic and aqueous extracts for diabetes, but considerable number of studies stated that the petroleum ether, benzene and chloroform extracts were also active against diabetes.^[55-57]

Various extracts including petroleum ether, chloroform, acetone, ethanol, aqueous and crude aqueous of barks of *Acacia catechu* (*A. catechu*) Willd (Leguminosae) and the two fractions of ethanolic extract were tested for anti-hyperglycaemic activity in glucose-

loaded hyperglycaemic rats. The effective extract and fraction of *A. catechu* were subjected to anti-diabetic study in alloxan-induced diabetic rats at two dose levels, 200 and 400 mg/kg, respectively. Biochemical parameters, including glucose, urea, creatinine, serum cholesterol, serum triglyceride, high density lipoprotein (HDL), low density lipoprotein (LDL), haemoglobin and glycosylated haemoglobin were also assessed. The ethanolic extract of

A. catechu and the water insoluble fraction of ethanolic extract exhibited significant anti-hyperglycaemic activity and produced dose- dependent hypoglycemia in fasted normal rats. Treatment of diabetic rats with ethanolic extract and water-insoluble fraction of this plant restored the elevated biochemical parameters significantly ($p < 0.05$) to the normal level. Comparatively, the water insoluble fraction of ethanolic extract was more effective than the ethanolic extract and the activity was comparable to that of the standard, glibenclamide (5 mg/kg).^[58]

In another study Albino rats ($n = 44$) were fasted for 48 h. Diabetes was induced by administering freshly prepared alloxan monohydrate 2.4% in normal saline subcutaneously at a dose of 120 mg/kg, body weight as single dose. After 72 h of alloxan, 18 h fasting blood was collected from those that survived ($n=34$) and blood

sugar estimated by glucose oxidase method. Twenty-four diabetic rats with blood glucose level of 300-500 mg% were selected and were divided into four groups of six each. The selected groups were treated with the vehicle (5% gum acacia, 1 ml/200 g), test drug (250 mg/kg, p.o.), test drug (500 mg/kg, p.o.) and glibenclamide (0.5 mg/kg, p.o.), respectively, for seven days. On the eighth day blood samples were collected after 18 h of fasting and blood glucose was estimated again.^[46]

The test drug, at a dose of 500 mg/kg, p.o. significantly lowered the blood glucose level ($P < 0.01$) as compared to the control group, at 2 h. However, the activity of the standard drug, glibenclamide (0.5 mg/kg/day), was more pronounced ($P < 0.001$). In alloxan induced diabetic albino rats, *Acacia catechu* at a dose of 250 and 500 mg/kg/day and standard drug glibenclamide (0.5 mg/kg/day) for seven days was highly significant ($P < 0.001$) in comparison with the control group. However, in diabetic rats the hypoglycaemic effect of the test drug at 250 mg/kg was significantly less than the standard drug glibenclamide.

Hence, *Acacia catechu* is proved to possess a significant Anti hyperglycemic activity.

Antisecretory and Antiulcer activity:

Karwani.G conducted a study on Antisecretory and Antiulcer activity of *Acacia*

catechu against indomethacin plus pyloric ligation induced gastric ulcers in rats. The results of their study suggest that *Acacia*

catechu causes an inhibitory effect on release gastric hydrochloric acids and protects gastric mucosal damage.^[59]

Table 3 :Pharmacological activity of various parts of *Acacia catechu willd.*

Scientific Name	Common Name	Family	Parts used	Pharmacological activity.
<i>Acacia catechu</i>	katha Khadira Karungali Black cutch.	Mimosaceae (Touch-me-not family)	Bark	Dysentery, diarrhoea and in healing of wounds, Antioxidant, healing of sore throat, gingivitis, Antidiabetic activity.
			Leaf	Hepatoprotective, Anti-secretory and Anti-ulcer, Antioxidant and Antibacterial, Anti-mycotic activity.
			Heartwood	Anti-bacterial, Anti mycotic, To treat mouthsores, gingivitis, dental caries It possess anti-oxidant and anti diarrhoeal activity. Ethyl acetate extract of <i>Acacia catechu</i> possess analgesic, antipyretic Hepatoprotective and Antidiabetic activity. Heartwood is used as a dyeing agent in textile industry.

Contraindications and Precautions ^[60]

The use of *Acacia catechu* is contraindicated in pregnant or breast-feeding patients. Products of the *catechu* family are also contraindicated in patients undergoing immunosuppressive therapy.

Discussion:

Indian medicinal herbs are used since ancient times to treat different diseases and

ailments as these natural products exert broad-spectrum actions. Katha is an extract obtained from the *Acacia catechu willd.*, it is generally used on different forms of the mouth ulcers treatment. It also possesses astringent properties and has a special place in the field of Ayurvedic medicine in the oral treatment. The phytochemical constituent, taxifolin present in it is responsible for the

antibacterial activity whereas catechin is responsible for the antioxidant activity.

Tannins are responsible for anti haemorrhagic, anti-inflammatory, antidiarrhoeal activity. Flavonoids present in *Acacia catechu* are responsible for the anti-inflammatory and anti-diabetic activity. According to Ayurvedic literature, Khadira is bitter and astringent in taste, pungent in the post digestive effect and has cold potency. It alleviates kapha and pitta dosas. It has a special potency to alleviate the skin diseases. It possesses light and dry attributes. It is used in the diseases like fever, edema, pruritis, diabetes, obesity, blood disorders, cough, asthma and anemia etc. For control of obesity, daily 3 gm cutch in 100 ml water is given as a drink. Within 3-6 months it wards off excessive body fats. It also works well as an adjunct in diabetes. Khadira is one of the most potent drugs, used in various skin diseases. Khadirarista is a famous preparation used for that purpose. The plant is extremely beneficial in vaginal diseases, leucorrhoea, menorrhagia etc. for which its decoction is commonly used. Khadira along with yastimadhu, helps healing the wounds and ulcers in vaginal and anal mucosa. In anal fistula, the decoction of its bark skin and triphala is given with ghee and vidanga powder. In skin infections due to kapha dosa, the decoction of khadira and amalaki is used with bakuci powder, with great benefit.

Conclusion :

The growth of the pharmaceutical industry and the unceasing development of new and more effective synthetic and biological medicinal products has not diminished the importance of medicinal plants in many societies. It is hoped that assessment of the traditional remedies could become the basis for a future classification of herbal medicines, as well as for evaluative studies on their efficacy and safety, and their potential use in national health care systems in different parts of the world.

Hence, the review focus on the various pharmacological activities and ayurvedic literature about *Acacia catechu* which will surely help the researchers to further continue their studies based on the identification and isolation of the active compounds responsible for treatment of various infectious diseases. *Acacia catechu* is thus considered as a potent medicinal plant a gift from Ayurveda to mankind.

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Conflict of Interest:

No conflict of interest in the present article.

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