



A brief study on importance of *acacia catechu*: A review

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Abstract

Acacia catechu willd has a great importance due to its medicinal properties. It is a historical plant; widely used in traditional medicine especially in Asia. Modern technology has made easy to study pharmacological properties of traditional medicine so great interests have been developed in historical traditional plants. There is a great use of Acacia catechu in dermatology and sore throat. Now a day's antimycotic, hypoglycaemic activity has also been reported. Phenols or polyphenols are the natural chemicals which are found in Acacia catechu. Phenolic compounds have similar basic structural chemistry as that of aromatic compounds and they contain a basic phenolic ring. They are also found in citrus fruits, chocolate and in many other plants. They have an astringent effect and are widely used in tanning of lathers. They are also used in cancer treatment, dermatological disorders and possess anti-microbial activity. One of the most important feature of these compounds is their anti-oxidant effect. Due to the presence of these compounds in Acacia catechu willd; this plant has gained a vital role in medicinal use. In this paper, effort is made to sum up the researches which have been done on Acacia catechu willd which will be helpful to know that how many aspects of this plant are yet to be explored.

Keywords: acacia catechu willd, catechin, flavonoids, tanning, alkaloids, arachidonic acid

Introduction

The body immediately responds to damaged tissues and cells which are caused by pathogens, certain stimuli such as chemicals or even by physical injury by inflammation^[1, 2]. Lately, inflammation has been described as "the succession of changes which occurs in a living tissue when it is injured provided that the injury is not of such a degree as to at once destroy its structure and vitality" or "the reaction to injury of the living microcirculation and related tissues"^[3]. Inflammation is of two types: acute and chronic inflammation. Acute inflammation is a short term response that usually results in healings. For example; leukocytes enter the area which is damaged, eliminate the stimulus and subsequently cure the tissues. Contrarily, chronic inflammation is a long time, and unregulated response that involves acute inflammation, tissue destruction and also attempts at tissue repair^[4]. Therefore, to treat any diseases with inflammatory reactions, natural products with anti-inflammatory action can be chosen. Acacia catechu is such a product with impeccable properties. There are about 1300 species of Acacia (family Mimosaceae), and its exudates, leaves, seeds, heartwood, and bark are used in numerous ways^[5]. Gum Acacia (gum arabic) has been used for its medicinal properties for approximately 2500 years. It is employed as a demulcent (soothing and protectant agent) and emulsifier, and is also employed to increase viscosity of solutions and suspensions. It is also used in the food, soft drink, textile, tanning, cosmetic, and confection industries. The traditional preparation of betel quid (paan masala), which consists of Piper betel leaves, A. catechu paste, chopped Areca nut, lime, and various spices with or without tobacco is done by using Acacia Catechu heartwood extracts^[6]. Betel chewing is used to produce euphoria, a sense of well-being, heightened sense of alertness, and psycho- stimulation.

Botanical description^[7]

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^[8]. 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^[9]. Powder- Catechu is used for diarrhea, swelling of the nose and throat, dysentery, swelling of the colon (colitis), bleeding, indigestion, osteoarthritis, and cancer^[10]. People apply catechu powder directly to the hemorrhoids and skin diseases and traumatic injuries; to stop bleeding; and fordressing wound^[11]. It is included in mouthwashes and gargles used for gum disease (gingivitis), pain and swelling inside the mouth (stomatitis)^[12], it is thought that catechu may contain chemicals that can decrease inflammation and kill bacteria.

Constituents: Catechin, catechu-tannic acid and tannin.

Pharmacognostical studies^[13]

- 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, unit 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 colored, under microscope shows a number of xylem fibres, vessels, crystal fibres, and prismatic crystals of calcium oxalate.

Medicinal uses [14]

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 [15].

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 *Penicillium marneffeii*. Disc diffusion technique was followed for screening antifungal activity. The discs were loaded with 50µl

of ethanolic extracts at different concentrations [25µg/disc, 250µg/disc and 500µg/disc]. Positive controls used were fluconazole (10 mcg/disc) and amphotericin B (100 units/disc). After incubation at 28°C for 48 hours, the zone of inhibition was measured. The extract at different concentrations showed varying degree of antifungal activity against the microorganisms tested compared to standard. [16] 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 [17].

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 [18].

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 analyzed by Dot- blot assay & quantitative analysis by DPPH radical scavenging assay with ascorbic acid as standard [19, 20].

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 chemo preventive effect of aqueous extract of *Acacia catechu* Willd heartwood maybe was due to its polyphenolic compounds that exhibit powerful antioxidant activity. [21] 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, fibrosarcoma 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 [22].

Antidiarrheal Activity

Ethyl acetate extract of *Khadira* (*Acacia catechu* Willd) was evaluated for antidiarrheal property in castor oil induced model of diarrhea in albino rats. *Khadira* (*Acacia catechu* Willd) at a doses of 250 mg/kg, p.o., (single doses) has been found to possess highly significant antipyretic activity (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 [23-30].

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 hemagglutination 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 [31]. 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 flavonoids in bark of *Acacia catechu* willd [32].

Miscellaneous uses

Used in India as an ointment for indolent ulcers and has been used in rural Bangladesh as a component of an antifertility pill, arresting nose bleeds, chronic gonorrhea can be treated with an infusion of catechu. [33] 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. [34] 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. [35] Manufacturing process of katha 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 liter 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 [35]. 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*. [36] 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. [37] 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 [38].

Conclusion

From the present study, it is envisaged that *A. catechu* has a great socio-economic importance as it is widely used for different purposes by the natives of Shivalik range. Besides, traditional and commercial importance, it has tremendous ecological significance. Because of its leguminous nature and soil binding abilities, it could be a suitable species for wasteland development. Literature studies indicate that *Acacia catechu* is biologically very active plant which makes it a very attention-able one, but there is a huge research gap. The need is to do more research to identify active constituents which are responsible for its biological activity. It has very potent anti-microbial, anti mycotic and hypoglycaemic activity due to the presence of alkaloids which also shows toxic effects at high doses. Medicinal use of *Acacia catechu* is confined to traditional or folk medicines which give clue that higher research should be made for new drug molecules of definite activity. As major constituents are reported to have very good anti-oxidant property which is comparable to ascorbic acid so its ethno-pharmacological studies should be conducted. As it has been used for very long time for sore throat and for dermatological disorders and there is a need to make better and modern preparations.

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