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Fabulous therapeutic benefits of multipurpose Katechu/Kattha (*Acacia catechu* linn. f. willd)

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Abstract
The heartwood of the tree is mainly used for extracting Katha and Cutch (decoction obtained after filtration) which are sold in the market. Katha is commonly used in ayurvedic preparations. Besides this, it serves as one of the major components in masticatory i.e. chewing of betel leaf (pan) in India. A. catechu is a valuable bioresources and has been exploited commercially in tannin and Katha industry for decades. Besides its commercial importance, it is equally significant for the people particularly rural communities living in the vicinity of catechu forests as it is a subsidiary source of income to them. *A. catechu* has received attention as a potential source of bioactive secondary metabolites to be used for the formulation of pharmaceutical products. Various parts of plant extracts were known to have strong antioxidant, antimicrobial, anti-inflammatory, antihyperglycemic, and immunomodulatory activities. Although several secondary metabolites have been identified from *A. catechu*, the molecules, catechin, epicatechin, and quercetin, are the principal contributor to therapeutical properties. Nowadays, plant-based secondary metabolites are extensively used in the management of various infectious diseases and achieved clinical benefits in the health care system. The objective of the present study includes the delineation on traditional applications, phytochemistry and pharmacological attributes of various parts of Acacia catechu tree.

Keywords: odontopathy, pharyngodynia, antihyperglycemic, tannin, catechin, immunomodulatory

Introduction
Acacia catechu (Linn. F.) Willd, also known as Khair is a deciduous and gregarious tree with a light feathery crown This tree is one of the most promising medicinal plants of the family Mimosaceae. Khair, is a medium sized tree with crooked and forked trunk. The bark is dark brown or dark grey on the outside, brown or red on the inside, 12-15 mm thick, tough, and exfoliates in long thin rectangular flakes that dangle often. The multipurpose tree, is local to the Indian Peninsula, especially in Maharashtra, Gujarat, Rajasthan, and Tamil Nadu, where it develops on bone-dry and rough soils. Tree is additionally used to make pulpwood, blunder, feed, gum, and has a scope of therapeutic properties. In Linnaean scientific categorization, the plant is known as khair in Hindi and kachu in Malay; as the kind species from which the concentrates cutch and catechu are inferred, the name was Latinized to "catechu."Kher, catechu, cachou, cutch tree,dark cutch, and dark catechu are a portion of its normal names. The article deals with the importance of Khair in the life of rural and tribal communities inhabiting Shivalik range in western Himalaya, India. Catechu is widely used by the inhabitants for fodder, fuel, building material and in health care. Information on traditional uses and socio-economic importance of A. catechu has been provided. [1-3] Generally, A. catechu forms pure patches of Khair forests but it is also found in association with Acacia modesta, Pinus roxburghii, Mallotus phillipensis, Dalbergia sissoo, Zizyphus and other species. In India, there are 3 varities of A. catechu namely, Catechu, Catechuoides and Sundra. Catechu is commercially used to obtain Katha (a concentrated filtered extract) in North India. It is found widely distributed in Jammu, Punjab, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar, Andra Pradesh and Orrissa. In Himachal Pradesh, catechu is widely distributed in Mandi, Hamirpur, Kangra, Solan, Sirmaur, Una, Chamba, Shimla and Bilaspur. It is found in terrai region of Sikkim, Assam and West Bengal, whereas Sundra, generally known as Lal Khair (red catechu) is found in Deccan, Gujarat, Rajasthan and southern Maharashtra. The heartwood of the tree is mainly used for extracting Katha and Cutch (decoction obtained after filtration) which are sold in the market. Katha is commonly used in ayurvedic preparations. Besides this, it serves as one of the major components in masticatory i.e. chewing of betel leaf (pan) in India. A. catechu is a valuable bioresources and has been exploited commercially in tannin and Katha industry for decades. Besides its commercial importance, it is equally significant for the people particularly rural communities living in the vicinity of catechu forests as it is a subsidiary source of income to them. To a certain extent, these people are dependent on this plant to fulfill their day to day need of fuel, fodder, building material and others. [4] This is the reason that catechu has become an integral part of socio-economic and cultural life of the people inhabiting the Shivalik range. Though, information on traditional uses of catechu has been reported earlier by some researchers but,

information on indigenous uses of catechu tree from Shivalik region has been undertaken presently. In this review we have concluded phytochemical and pharmacological properties of Kath along with its uses in Unani system of medicine. [5-7]

Acacia catechu is also known as kattha (Urdu), khadir (Hindustani and Punjabi), khoyer (Bengali and Assamese), khair and babul (Hindi), kaath (Marathi), and kachu (Malay). It is indigenous in India, other Asian countries, and East Africa. Traditionally, *A. catechu* has been used as an antimicrobial, anti-inflammatory and antifungal, coagulant, vermifuge, antidiarrheal, and astringent, and has also been employed to heal wounds, treat obesity and diabetes, and maintain oral hygiene. In recent years, numerous studies have examined various pharmacological properties of extracts prepared from heartwood, bark, leaves, seeds, and seed pods of *Acacia* species. *Acacia catechu* extracts have also played a role in chemistry, with various names of chemicals as catechin, catechol, and catecholamine being derived therefrom. Various studies have shown that *A. catechu* heartwood is an excellent source of catechins and epicatechins as well as flavonoids, which have a high degree of antioxidant activity. [8-10] The antioxidant activity has been well demonstrated by both *in vitro* and *in vivo* studies. The antioxidant activity is believed to be responsible for the anti-inflammatory, antineoplastic, tissue protectant, and analgesic activities that have been demonstrated, and may be related to the antihypertensive and antidiarrheal effects. In spite of the long-term use of *A. catechu* and the general safety of catechins and epicatechins, there is a need for additional well-controlled safety studies in animals and humans. Additional well-controlled human efficacy studies are also needed. Furthermore, few studies have attempted to relate various effects to specific constituents. [11-12]

Fig 1: Photos of Catechu Tree and its various parts

Bark of Catechu tree & its powder

Fig 2: Bark of Catechu tree & its powder

Traditional and Therapeutic Applications

Acacia catechu has been widely used in Ayurveda for treating many diseases. Its heartwood extract is used in asthma, cough, bronchitis, colic, diarrhea, dysentery, boils, skin afflictions, sores and for stomatitis. The decoction of heartwood is used for drinking purpose in southern part of India especially in Kerala. *A. catechu* has received attention as a potential source of bioactive secondary metabolites to be used for the formulation of pharmaceutical products. Various parts of plant extracts were known to have strong antioxidant, antimicrobial, anti-inflammatory, antihyperglycemic, and immunomodulatory activities. Although several secondary metabolites have been identified from *A. catechu*, the molecules, catechin, epicatechin, and quercetin, are the principal contributor to therapeutical properties. Nowadays, plant-based secondary metabolites are extensively used in the management of various infectious diseases and achieved clinical benefits in the health care system. [13-15] Most of the people in Kerala use boiled Khadira water (karingali water) for drinking purpose. The heartwood of Khadira is used in melancholia, conjunctivits, haemaptysis, catarrah, cough, pruritus, leprosy, leucoderma, skin diseases, helminthiasis, norexia, diarrhea, dysentery, foul ulcers and wounds,

haemoptysis, haematemesis, haemorrages, fever, anaemia, diabetes and pharyngodynia. The tree's many components are utilized for variousclinical purposes, including haemoptysis (spitting blood).Conjunctivitis can be treated with bark glue. Snakechomps are professed to be dealt with effectively utilizing the bark. Blossoms: A mix of bloom tips, cumic, milk, and sugar is successful for gonorrhea. Cutch and katha, both got from the heartwood, have a huge restorative worth. It's a cooling, stomach-related, and astringent spice that is utilized to treat illnesses including constant loose bowels and diarrhea, draining heaps, uterine hemorrhages, leucorrhoea, gleet, a tonic dyspepsia, ongoing bronchitis, and the sky is the limitfrom there. It can likewise assist with inconsistent salivation, dying, ulcerated, or springy gums, tonsil hypertrophy, uvulaunwinding, and a phthous ulceration of the month. A blend of catechu and myrrh (Kathol) is broadly encouraged to ladies as a tonic and galactagogue after labor. Kheersal is utilized to treat asthama, hack, and sore throat, among other chest problems. [16-17]

In Unani system of medicine, it carry cold and dry temperament which exploit as Qabiz, Habis, Daf'e jiryan wa sailan, Mujaffif, Raade, Musaffie khoon properties. Alkaloids of this plant acts on mostly all system of human body and maximum it contains antibacterial, antifungal and anti-inflammatory properties. Animal studies also show hepatotoxic, nephrotoxic and antihyperlipidemic activity.

Juice of fresh bark is given with asafetida in haemoptysis and the flowering tops which cumin, milk and sugar in gonorrhoea. Mixed with aromatics it is used in melancholia powered and mixed with water it is used in conjunctivitis. Khersa or Catechuic acid is found in cavities of wood and used as a remedy in chest affections and it promote expectoration. It is medicinally used as an astringent in fevers and other maladies. It is used in diarrhoea with pyrosis, depending upon a relaxed state of intestinal mucous membranes. It is used in sponginess of gums, relaxation of uvula, hypertrophy of tonsil and as an astringent injection of treatment of leucorrhoea and a tonic in menorrhagia. *Acacia catechu* heartwood extracts have also been used traditionally in the preparation of betel quid (paan masala), which consists of *Piper betle* leaves, *A. catechu* paste, chopped *Areca* nut, lime, and various spices with or without tobacc. Betel chewing is used to produce euphoria, a sense of well-being, heightened sense of alertness, and psycho-stimulation. [18-19].

Bark is useful for melancholia, conjunctivitis and hemoptysis. Heartwood extract is astringent, acrid, cooling, depurative, anthelmintic, antiseptic, anti-dysenteric, antipyretic, appetizer, anti-leprotic, hematinic, hemostatic, anti-inflammatory, tonic, blood purifier, heptoprotective, hypoglycemic and hypotensive. Useful for urinary and vaginal discharges, excessive mucus discharges, hemohhrages, relaxed condition of gums, throat and mouth diseases, catarrh, cough, pruritis, leprosy, leukoderma, bronchitis, stomatitis, irritable bowls syndrome, lipid disorders, skin diseases, elephantiasis, erysipelas, helminthes, anorexia, diarrhea, dysentery, foul ulcer, wounds, hemoptysis, hematemesis, intermittent fever, inflammations, odontopathy, obesity, intestinal wounds, contaminated urination, anemia, diabetes, spleenopathy, pharyngodynia and colporrhegia. [20-21] Root extract is anti-bacterial, anti-fungal. Seeds are hypoglycemic. The decoction of bark mixed with milk is taken to cure cold and cough.

The bark decoction is either alone or used in combination with opium to cure severe diarrhea. Katha after drying is applied on lemon slice and taken regularly with empty stomach to cure piles. Heartwood of khair is boiled with other ingredients to prepare the decoction. It is considered beneficial to cure the body pains. Katha or decoction of heartwood is applied in mouth and on tongue to cure mouth ulcer. It is also applied externally on ulcers, boils, skin eruptions and on gums as disinfectant [22-23].

Phytochemical Constituents

The important chemical constituents reported in the heartwood are catechin, catechutannic acid, epicatechin, catechin tetramer, dicatechin, gallocatechin, kaempferol, taxifolin, isorhamnetin, (+) afzelechinn, L-arabinose, D-galactose, D-rhamnose and aldobiuronic acid. The medicinal properties of Acacia catechu may be due to the antioxidant properties of these constituents.

Chemical constituents are well known for their potential health benefits and have been reported to possess valuable biological activities such as antibacterial and antifungal, antioxidant, antiurolithiatic, anticonvulsant and anxiolytic, and hepato protective properties. Bark contains catechin, catechu tannic acid, tannin. Wood yields α, β, γ - catechin and I-epicatechin. Gum consists of D-rhamnose, L-glucuronic, L-arabinose and D-galactose. HPLC (High-performance liquid chromatography) coupled with electrospray ionization mass spectroscopy of an aqueous extract of the heartwood and leaves of *A. catechu* has shown that the primary constituents are catechins, which by definition are gallic acid (polyhydroxylated benzoic acid) derivatives and polymers. [20-23] The predominant catechins in *A. catechu* include catechin, epicatechin, epicatechin-3-*O*-gallate, and epigallocatechin-3-*O*-gallate. Other major secondary products present in the extracts included flavonol glycosides, flavonal dimers, and caffeine. Other constituents that have been identified in aqueous extracts of *A. catechu* include rhamnetin, 4-hydroxyphenol, 3, 3′, 5, 5′, 7-pentahydroxyflavane, fisetinidol, 5-hydroxy-2-[2-(4-hydroxyphenyl)acetyl]-3-methoxybenzoic acid, and (2S,3S)-3,7,8,3′,4′-pentahydroxyflavane. The presence of high amounts of gallic acid-derived compounds is primarily responsible for the astringent, tanning, and antioxidant properties of the extracts. An extract from the heartwood of *A. catechu* was shown to contain 66.9% catechin and 23.1% epicatechin; thus, 90% of the composition of this extract consisted of these two component. [21-24].

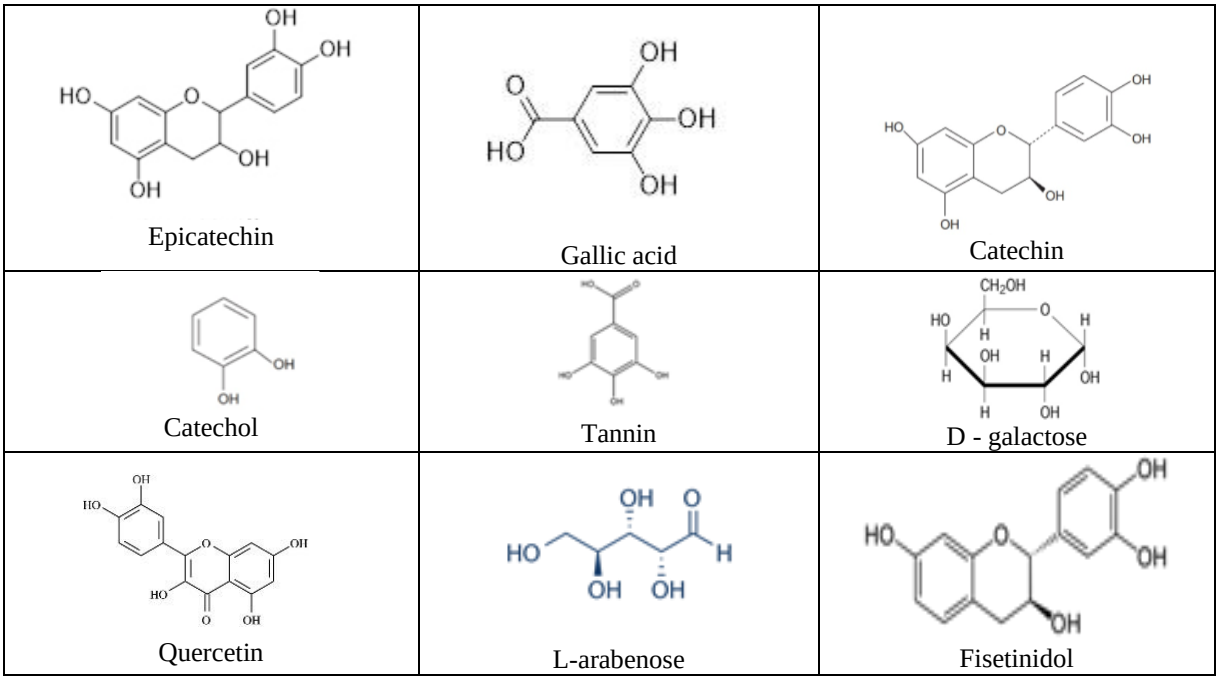

Fig 3: Structure of some chemical compounds occurring in catechu tree

Discussion and Conclusion

The aqueous extract of *A. catechu* heartwood has been shown to be a rich source of catechin and epicatechin, with smaller amounts of flavonoids, chemicals with well-recognized antioxidant properties. Extraction with organic solvents as ethyl acetate, ethanol, methanol, hexane, and chloroform results in products with differing chemical compositions and subsequently differing physiological and pharmacological activities. The antioxidant properties of *A. catechu* heartwood extract has been demonstrated in a variety of *in vitro* systems and *in vivo* studies in rats, mice, and cell culture systems. The anti-inflammatory, antineoplastic, and analgesic activities are all believed to be due to the antioxidant activities, although no direct associations have been made. Various studies involving catechin-rich and epicatechin-rich fractions from other plants have demonstrated antineoplastic, analgesic, and anti-inflammatory properties. As a consequence, it is not surprising that various extracts of *A. catechu* exhibit these properties because of the presence of catechins and flavonoids. [25-27] Mechanistically, the extracts of *A. catechu* heartwood has been shown to enhance various antioxidant enzymes, increase cellular content of reduced glutathione, which is one of the primary endogenous antioxidants, and inhibit lipid peroxidation and DNA damage. Antioxidant, anti-inflammatory, free radical-scavenging, and tissue-protective effects of heartwood extracts have been well documented, contributing to the overall safety. Furthermore, no adverse events have been reported when *A. catechu* heartwood extracts alone or in combination have been used in human subjects and animals. Several studies in animals and cell culture systems have also examined the anti-inflammatory and analgesic properties as well as the safety of the proprietary combination of *S. baicalensis* and *A. catechu* extracts. Although these results are very promising, the studies do not provide information on *A. catechu* alone and its relative contribution to the proprietary blend. Finally, as previously noted, *A. catechu* heartwood extract is used as a component of betel quid. Oral cancer and epithelial dysplasia are known to be associated with the chewing of betel quid and are believed to be due to the production of reactive oxygen species and free radicals. Because of its antioxidant and free radical-scavenging ability, *A. catechu* heartwood extract may serve as a protectant and antineoplastic in betel quid. *Acacia catechu* extracts have been shown to exhibit antineoplastic and antiproliferative activities. [28-30]

The therapeutic use of this tree is confined to traditional/ folk medicines, giving higher research for new drug molecules of definite activity. It has potent anti-microbial and hypoglycaemic activity due to the presence of alkaloids. This indigenous tree is used to treat number of ailments like haemmorage, sore throat, diarrhoea, bleeding of gums, fever, cough and cold etc. The heartwood extract of Acacia catechu exhibits various pharmacological actions. Various parts of plant extracts were known to have strong antioxidant, antimicrobial, anti-inflammatory, antihyperglycemic, and immunomodulatory activities. Although several secondary metabolites have been identified from *A. catechu*, the molecules, catechin, epicatechin, and quercetin, are the principal contributor to therapeutical properties. Nowadays, plant-based secondary metabolites are extensively used in the management of various infectious diseases and achieved clinical benefits in the health care system. Hence, there is a need to make better and more modern approaches for different uses. The need is to do more research to identify active constituents which are responsible for its biological activity. This 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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