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Conservation of Acacia catechu forests by exploring its benefits for the modern day society

Home Science

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Rachna Pandey Govt. M.H. College of Home Science and Science for Women, Jabalpur

ABSTRACT

Acacia catechu has been a plant of attraction from ancient times due to the medicinal benefits as well as for famous astringent called "Kaththa". Due to the expanding needs of the society, the Acacia forests are being sacked. There is a large debate that such forest crops are not much useful in comparison to the modern day demand for housing and agricultural needs. Our research has provided a new insight to the use of *Acacia catechu* from Jabalpur region as a food source. The proximate analysis has revealed the balanced nutrition by A. catechu pods apart from nutritionally important minerals as well as antioxidant properties. It is highly recommended to initiate a campaign to popularize the use of such pods for culinary purposes. This approach will serve the dual purpose of conserving this important forest crop as well as to enhance its use as an alternative food source.

Introduction

Acacia catechu also commonly called *Mimosa catechu* is a deciduous, thorny tree which grows up to 15 m (50 ft) in height. The plant is called khair in Hindi, and kachu in Malay, hence the name was Latinized to "catechu" in Linnaean taxonomy, as the type-species from which the extracts cutch and catechu are derived. Common names for it include catechu, cachou, cutchtree, black cutch, and black catechu (Usher, 1984). *Acacia catechu* is widely distributed throughout the greater part of India except the most humid, cold and the driest regions. It is common in the sub-Himalayan tract and outer Himalayas ascending from 900 to 1,200 m from Jammu to Assam. *Acacia catechu* is essentially a tree of comparatively dry regions though in its alluvial form, it extends into regions of heavy rainfall as in the Eastern sub-Himalayan tract, where it is found in places with rainfall as high as 3,800 mm. Away from riverain tracts it occurs in localities where the normal rainfall varies from 500 to 2160 mm. Khair develops to its maximum size in localities with heavy rainfall but it is decidedly xerophilous and grows in dry situations where few other species survive.

On account of its hardness and value of wood, khair is an ideal species for the conversion of miscellaneous forests, containing inferior species and is being used to a considerable extent for afforestation in the state of Uttar Pradesh (India). It plays an important part in the afforestation schemes of narrow valleys of some parts of the state. Experiments carried out to investigate the possibility of afforesting non fertile lands indicate that the species is moderately suitable in mild non-fertile land, if planting is done in deep pits filled with better soil. Given that the utility of the tree in natural conservation, *A. catechu* offers a spectrum of utilities, for which it should be protected during deforestation.

General Uses

Acacia catechu is one of the good sources for useful timber. The timber is hard, steady and tough, especially if the wood is old and dry after seasoning. The wood can, however, be finished to an extremely smooth surface and takes polish well. It is mainly used for making posts in house construction, rice pestles, oil and sugarcane crushers, ploughs, tent-pegs, sword handles and keels and knees of boats.

Acacia catechu is also used as a fodder tree to feed goats and cattle. The leaves of *A. catechu* contain good nutritional value and contain 13-14% protein and up to 40% carbohydrtaes and the nutritive value of 170 Kcal per 100 g (Verma et al., 2014). The nutritive value shows that the leaves can be fed for cattle on the basis of crude protein, crude fibre and carbohydrate contents.

Nutrition and culinary uses

Plant based ingredients are commonly used as a food source, and mostly the plant based secondary metabolites are taken with the food, which perform therapeutic as well as medicinal role in the body. Especially the Indian food; which is prepared according to the Ayurveda; advocate the inclusion of such plant based ingredients that provide therapeutic inputs to the body along with the nutrition (Verma et al., 2014b). In this way, they increase the immunity and help in making the human being fit and healthy.

According to world agro-forestry database, the tree's seeds are a good source of protein. Kattha (catechu), an extract of its heartwood, is used as an ingredient to give red color and typical flavour to "Paan". Fresh pods of *A. catechu* are used for culinary purposes in different parts of Latin America. Recently, the young pods of *A. catechu* from Jabalpur (India) were described for their nutritive values as well as for its antioxidant capabilities (Verma et al., 2014).

Siddhuraju et al. (1996) investigated nutritional and anti nutritional characteristics and biological value of Acacia nilotica (L.) Del. seeds only. Velázquez et al. (2011) investigated the pods of Acacia farnesiana to be included as major diet source in lamb food. The mature seeds contained 234 g kg^{-1} crude protein, 126 g kg^{-1} crude fibre, 66.6 g kg^{-1} crude fat and 39.7 g kg^{-1} ash and 534 g kg^{-1} carbohydrates. Potassium, phosphorus, magnesium, iron and manganese occurred in high concentrations. Such reports provide a good database on nutritive values of the seeds and pods of the Acacia which can of great use especially for the rural India.

Traditional Medicinal Uses

Balz (1994) used different parts of *Acacia catechu* as a traditional medicine in India and other countries. Bark of *A. catechu* tree is strong antioxidant, astringent, anti-inflammatory, anti-bacterial and anti-fungal in nature. It is useful in passive diarrhea, high blood pressure, dysentery, colitis, gastric problems, bronchial asthma, cough, leucorrhoea and leprosy. It is used as a mouthwash for mouth, gum, sore throat, gingivitis, dental and oral infections.

As per Aurveda, bark, wood, fruit extract, gum and flowering tops of *Acacia catechu* are used for medicinal purpose. The plant is useful, internally as well as externally. Used externally as a powder, it arrests the bleeding in gums. The decoction is an effective gargle in sore throat, cough and hoarseness of voice (Bray, 1999; Zhao et al., 2005). The paste is beneficial, externally, in skin diseases and wounds. The bath of its decoction is effective for skin infections. In stomatitis, halitosis, dental caries and cavities *Acacia catechu* is used with great benefit. Kattha. Kattha (extract) is astringent, cooling, and digestive. It is useful in cough, diarrhea, ulcers, boils and eruptions of the skin. In India, it is used as an astringent in "Pan" and also chewed with beetle nuts for astringent effects. Decoction of bark is given internally in case of leprosy. It helps to cure piles when taken with lemon regularly.

Internally, *Acacia catechu* is useful in vast range of diseases. The decoction of *Acacia catechu* along with fennel is salutary in diarrhea, dysentery and colitis, especially associated with bleeding. The decoction of *Acacia catechu*, given along with honey, effectively curbs the haemoptysis (bleeding through sputum) and alleviates the cough due to kapha dosa. In chronic fever with enlarged spleen, its decoction is beneficial (www.himalayaherbal.com).

Acacia catechu along with 'Yastimadhu' (Licorice/Glycyrrhiza glabra) helps healing the wounds and ulcers in vaginal and anal mucosa. In anal fistula, the decoction of its bark skin and triphala [A combination of Amalaki (*Emblica officinalis*), Bibhitaki (*Terminalia bellirica*), and Haritaki (*Terminalia chebula*) is given with ghee and vidanga (*Embelia ribesi*) powder. In skin affections due to kapha dosa, the decoction of khadira (A. catechu) and amalaki (*Phyllanthus emblica*) is used with bakuchi powder (*Psoralea corylifolia,* Papilonaceae family), with great benefit (www.himalaya-herbal.com).

Deshpande and Patil (1981), Li et al. (2000, 2001), Burnett et al. (2007) have reported antiviral, anti-allergic, antiplatelet, anti-inflammatory, antitumor and antioxidant activities of *Acacia catechu.* Verma et al. (2013) demonstrated antimicrobial activity of *Acacia catechu* Willd collected from Jabalpur region.

Major Phytochemicals

Sharma et al. (1999) showed that sterols or steroid alcohols have been shown in clinical trials to block cholesterol absorption sites in the human intestine, thus helping to reduce cholesterol in humans. Further, the bark and root of *Acacia catechu* contain flavanoids: quercetin, 3-methylquercetin, dihydrokaempferol, taxifolin; steroids: poriferasterol; triterpenoids: lupenone, lupeol.

Yadava et al. (2001) studied flavanoids from the trunk of *Acacia catechu* : Yadava et al. (2002) isolated major flavanoids quercitrin, hyperin and quercetin-3-O-arabinofuranoside from the leaf.

Noreen et al. (1998), Naik et al. (2002) described the Action of different phytochemicals from *Acacia:*

- Tannins: Acts topically to astringent mucosal surfaces and following oral ingestion and consequent hydrolysis 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.

- Flavanoids: Have property to increase secretion of insulin and inhibit cycloxygenase and lipoxygenase so has anti diabetic and anti inflammatory effect.

- Catechins: Have significant antioxidant and antimicrobial effects. It is considered to be the best antioxidant.

Ritner (1997) reported the genus *Acacia* contains a number of organic compounds that defend them from pests and grazing animals. Many of these compounds are psychoactive in humans. Naik et al. (2003) showed that *Acacia catechu* mainly contains catechins and flavanoids. Chinese Pharmacopoeia specifies that the total content of catechin and epicatechin in *Acacia catechu* shall not be less than 21% as determined by high performance liquid chromatography in order to control the quality of the medicinal materials.

Pharmacological activity:

Medicinal plants constitute the main source of new pharmaceuticals and health-care products. Verma and Dahake (2010) described the important advantages claimed for therapeutic uses of medicinal plants in various ailments are their safety besides being economical, effective and easy availability. Because of these advantages, the medicinal plants have been widely used in traditional medicinal practitioners in their day to day practice.

1. Antimicrobial activity:

Li et al. (2000, 2001) Zhao et al. (2005) investigated in vitro antimicrobial activity of Acacia catechu aqueous extract. They found it was effective in inhibiting clinical strains such as Staphylococcus aureus, *Staphylococcus epidermidis, Enterococcus, Klebsiella pneumonie,* and *E. coli.*

Negi and Dave (2011) reported *in vitro* antimicrobial activity of *Acacia catechu* and its phytochemical analysis. The ethanolic extract of this plant was found to have antimicrobial activities against six species of pathogenic and non-pathogenic microorganisms: *Bacillus subtilis, Staphylococcus aureus, Salmonella typhii, Escherichia coli, Pseudomonas aeruginosa* and *Candida albicans.*

Saini et al. (2008) performed comparative pharmacological and antimicrobial studies of Acacia species (Mimosaceae) revealed that various Acacia species have been reported to be effective against a variety of disease including malaria, leprosy and most concerning cancer. The fresh plant parts of different Acacia species are considered as astringent, spasmolytic, demulcent, anthelmintic and abortifacient in Indian traditional medicine system.

Patel et al. (2009) reported on antimicrobial screening and phytochemical analysis of the resin part of *Acacia catechu* Kattha, which is used as a chewing ingredient. Antimicrobial testing demonstrated excellent results with the petroleum ether extract against *Pseudomonas aeruginosa* (l0 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 as active ingredients in the extract.

Laxmi et al. (2011) recently investigated *in vitro* antibacterial activity of ethanolic bark extract of *Acacia catechu* wild against selected oral microbes and to investigate the phytochemicals present in it. The ethanolic bark extract of *Acacia catechu* exhibited antibacterial activity against *streptococcus mitis* with minimum bactericidal concentration of 500µg/ml whereas the MBC for *Streptococcus sanguis* and *Lactobacillus acidophilus* were found to be 1mg/ml, 5mg/ml,10mg/ml and the phytochemical analysis revealed the presence of tannins, flavanoids, amino acids, saponins, triterpenoids. Paul et al. (2013) were successful in showing that the herbal toothpaste that contained Acacia as main ingredient were able to kill food borne bacteria, resident on teeth.

2. Convergence/homeostasis activities:

Liu et al. (2004) reported the topical use of catechin, a major constituent from *Acacia catechu* on wounds and burns induced coagulation of exudates proteins forming scar tissues in the surface, preventing bacterial infection and causing vasoconstriction on the wound surface, resulting in topical homeostasis.

3. Hepato-protective activities:

Danni et al. (1977), Lu (1991), Fang et al. (1992) reported that R-catechin reduced CCl4 or galactosamine-induced activities of glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), and lactate dehydrogenase (LDH) in rat liver cell culture medium, exhibiting potent anti-hepatotoxic activity. *In vitro* R-catechin increased the rate of demethylation of aminophenazones in the endoplasmic reticulum of the rat liver, and inhibited CCl_4-induced lipid peroxidation.

Jayasekhar and Mohanan (1997) investigated the hepatoprotective activity of ethyl acetate extract of *Acacia catechu*, kattha by inducing acute liver damage in albino rats. Ethyl acetate extract of "kattha" inhibited carbon tetrachloride induced liver toxicity in albino rats.

4. Blood pressure reducing activity:

Sham et al. (1984) reported that the *Acacia catechu* water extract (i.v.) significantly reduced the blood pressure of anesthetized dogs, while also inhibited argipressine- or methoxamine-induced contraction of isolated rat tail artery. The mechanisms could relate to vasodilation and bradykinins.

5. Anti-ulcer activity:

Kesarwani et al. (2011) evaluated the possible antisecretory and antiulcer activity of crude bark extract of *Acacia catechu.* Administration of crude extract of *Acacia catechu* (400mg/kg/day) significantly

reduced ulcer index when compared with indomethacin induced gastric ulcerative rats. Extract treated animals also significantly reduced volume of gastric secretion, free acidity and total acidity. A significant increase in total carbohydrate / total protein ratio of gastric juice was also observed. *Acacia catechu* was found to be an active anti ulcerogenic agent. The result suggests that *Acacia catechu* cause an inhibitory effect on release gastric hydrochloric acids and protects gastric mucosal damage.

6. Antidiarrhoeal activity:
Ray et al. (2006) reported the *Acacia catechu* extract significantly decreased the number of stools passed and is as effective as the standard drug diphenoxylate. The anti diarrhoeal property appears to be due to its tannin contents which have astringent property. The study was done on castor oil induced diarrhea in albino rats.

7. Anti-inflammatory activity:
The extracts of *Acacia catechu* act as a dual inhibitor of Cyclooxygenase and 5-Lipoxygenase to reduce inflammation (Burnett et al., 2007). A mixed extract containing two naturally occurring flavanoids, baicalin from *Scutellaria baicalensis* and catechin from *Acacia catechu*, was shown to inhibit cyclooxygenase (COX) and 5-lipoxygenase (5-LOX) via enzyme, cellular, and in vivo models. These results suggest that this natural, flavonoid mixture acts via "dual inhibition" of COX and LOX enzymes to reduce production of pro-inflammatory eicosanoids and attenuate edema in an in vivo model of inflammation.

8. Antipyretic activity:
Ray et al. (2006) found that ethyl acetate extract of *Acacia catechu* in doses of 250 and 500 mg/kg significantly reduced the temperature of pyretic animals and illustrated significant hypoglycemic activity as well. The extract of *Acacia catechu* was found to have antipyretic effect may be due to flavanoids as they are predominant inhibitors of cycloxygenase and lipoxygenase.

9. Hypoglycemic activity:
Ray et al. (2006) showed in their study that in alloxan induced diabetic albino rats in which rats were given the extract of *Acacia catechu* and compared with standard drug glibenclemide (oral hypoglycemic drug); The result showed hypoglycemic effect of *Acacia catechu* but less then that by standard drug. The effect was may be due to presence of flavanoids, which act as insulin secretagoges, epicatchin a flavonoid compound is reported to promote regeneration of beta cells of Islet of Langerhans.

10. Antidepressant and anxiolytic property:
Gautam et al. (2009) reported that *Acacia catechu* has the antidepressant effect same as that of imipramine. Also it was found to have the anxiolytic effect but less than lorazepam on white albino rats.

11. Inhibition of Lipase and Glucosidase Activities:
Ikarashi et al. (2011) announced that the *Acacia* polyphenol is rich in unique catechin-like flavan-3-ols, such as robinetinidol and fisetinidol when it was extracted from the bark of the black wattle tree (*Acacia mearnsii*). In an *in-vitro* study, the inhibitory activity of these polyphenols on lipase and glucosidase was shown.

12. Antioxidant activity:
Antioxidants such as Vitamin-C & E boost our immune system. Certain phytochemicals have beneficial effect on heart diseases. Antioxidants lower the level of Low-density lipoprotein (LDL) cholesterol, thus preventing plaque deposition in the blood vessels. It is also beneficial in cancer prevention. Antioxidants neutralize substances that can damage the genetic material by oxidation.

Wu et al. (2006), Hazra et al. (2010) reported the antioxidant as well as iron chelating and DNA protective properties in water: methanol extract from *Acacia catechu* which were associated with phenolic and flavonoids compounds in the extract. The extract was able to scavenge DPPH, superoxide, nitric oxide, peroxynitrite, hydrogen peroxide, singlet oxygen and hypochlorous acid radicals.

Guleria et al. (2011) evaluated the antioxidant activity of different part's (leaf, bark and heartwood) extracts of *A. catechu* with their protective effect against plasmid DNA strand scission. The ethyl acetate fraction of heartwood showed the highest antioxidant capacities particularly in free radical scavenging activity, including DPPH radicals, superoxide anions and hydroxyl radicals. As for the chelating power on ferrous ions, leaf extract was more effective than bark and heartwood extracts. Furthermore, the ethyl acetate and acetone fractions of heartwood significantly protected pBR322 supercoiled plasmid DNA against strand scission induced by hydroxyl radicals in a Fenton's reaction mixture.

Li et al. (2011) reported two new phenolic compounds, 5-hydroxy-2-[2-(4-hydroxyphenyl) acetyl]-3-methoxylbenzoic acid (1) and (2S,3S)-3,7,8,3′,4′-pentahydroxyflavane (2), obtained from the aqueous extract of *Acacia catechu*, along with four known compounds identified as rhamnetin (3), 4-hydroxyphenyl ethanol (4), 3,3′,5,5′,7-pentahydroxyflavane (5), and fisetinidol (6). We have also shown the peroxide as well as DPPH scavenging activities in vitro from young pod extracts of *Acacia catechu* collected from Jabalpur region (Verma and Pandey, 2014).

Conclusion
Acacia catechu occurs in tropical moist deciduous forests, dry tropical forests and tropical thorn forests. *Acacia catechu* is essentially a tree of comparatively dry regions though in its alluvial form, it extends into regions of heavy rainfall as in the Eastern sub-Himalayan tract, where it is found in places with rainfall as high as 3,800 mm. Away from riverain tracts it occurs in localities where the normal rainfall varies from 500 to 2160 mm. Khair develops to its maximum size in localities with heavy rainfall but it is decidedly xerophilous and grows in dry situations where few other species survive.

On account of its multi variate usefulness and value of wood, *Acacia catechu* is an ideal species for the conversion of miscellaneous forests, containing inferior species and is being used to a considerable extent for afforestation. We strongly advocate that the Acacia forests should be conserved for sustainable development.

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