International Journal of Medical Sciences & Pharmaceutical Research, Volume1, Issue1, Jan-Jun-2017, pp 73-81

MEDICINAL PROPERTIES OF ABUTILON INDICUM

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ABSTRACT

Abutilon indicum is a common Indian shrub, belonging to the family Malvaceae. It has been extensively used as a traditional medicine as a laxative, emollient, analgesic, anti-diabetic, anti-inflammatory and blood tonic agent and also in the treatment of leprosy, urinary disease, jaundice, piles, relieving thirst, cleaning wounds and ulcers, vaginal infections, diarrhea, rheumatism, mumps, pulmonary tuberculosis, bronchitis, allergy, blood dysentery, some nervous and some ear problems. Various studies on the plant extract have been performed to confirm the anti-oxidant, anti-bacterial, analgesic, anti-inflammatory, anti-cancer, hepato-protective, immuno-modulatory and larvicidal activities of the plant. A review on the various studies on the plant has been provided for the purpose of understanding its medicinal properties.

Key words: Abutilon, Indicum Indian shrub, Medicinal, plant

Introduction:

Abutilon indicum, commonly called as “Thuthi”(3) or “Kanghi” in hindi, is a native plant of South Asia(16). The plant comes under the family of Malvaceae and is called as *Krob-Fun-Si* or *Ma-Kong-Khaao* or *Fun-si* in Thai. It is an erect, branched shrub with a height of 0.5- 1.0m, having cog-like fruits (15). *A.indicum* is abundant in wastelands and distributed in hotter parts of India (3).

A.indicum is used in the Siddha system of medicine(36). The plant finds uses as a laxative, emollient, as aphrodisiac, analgesic (1), hepatoprotective (27), antifertility (11), antipyretic, anti-cough, blood tonic, carminative, diuretic, antidiabetic, and anti-inflammatory agent (4). The plant extract is used for the treatment of leprosy, urinary disease, jaundice, piles, relieving thirst, inflammation of the bladder, cleaning wounds and ulcers, vaginal infections, diarrhea, rheumatism, mumps, pulmonary tuberculosis, bronchitis, allergy, blood dysentery, some nervous and some ear problems (15,29,5). *A.indicum* is the highly cited plant for the treatment of hemorrhoid (22).

The leaf extract of the plant possesses hypoglycemic, hepatoprotective, antibacterial and larvicidal properties and the juice from leaf is used for quick healing of ulcer (29, 30, 23). The roots have antibacterial and antifungal, diuretic activities and is taken for the relief of hematuria and treatment of leprosy (15). The seeds of the plant are aphrodisiac, laxative for hemorrhoid, treatment of cough, puerperal disease, urinary disorders, chronic dysentery, fever (27, 10, 33). The ethanolic extract of the plant has anti-inflammatory activity. Polyherbal formulations of the plant are used for treating diabetes, hyperlipidemia and as a free radical scavenger (12, 21, 13). A review of the various medicinal properties of the plant is provided to aid future research purposes.

Phytochemical analysis:

Phytochemical analysis of the plant has shown that the plant is made up of flavanoids, steroids and terpenoids, saponins, alkaloids and glycosides which contribute to the medicinal properties of the plant (17). Studies on the methanolic extract of the dried flowers yielded seven flavonoid compounds such as luteolin, chrysoeriol, luteolin 7-*O*-β-glucopyranoside, chysoeriol 7-*O*-β-glucopyranoside, apigenin 7-*O*-β-glucopyranoside, quercetin 3-O-β-glucopyranoside and quercetin 3-o-α-rhamnopyranosyl (1→6)-β-glucopyranoside (20).

Anti-oxidant activity:

Antioxidants are substances which are capable of scavenging free radicals which damage bio molecules such as proteins, lipids, carbohydrates and DNA (7).

The anti-oxidant activity of the plant extracted with petroleum ether, chloroform, ethyl acetate, *n*-butanol, ethanol and water was studied. Investigations on the DPPH scavenging activity of the extracts showed that all the extracts possess good DPPH scavenging potential.The ethyl acetate extract was found to possess highest activity in free radical scavenging which was studied by Hydrogen peroxide scavenging assay, OH radical degradation assay and Nitric oxide radical inhibition assay.

This study also revealed that there was no significant co-relation between the anti-oxidant potential of the extract and their total phenolic and flavonoid content (32).

In another study, the extracts of the leaf aerial and root of the plant were obtained with *n*-hexane, chloroform, ethyl acetate and *n*-butanol. The study indicated that the aerial parts of the plant possess better anti-oxidant potential compared to the root. The ABTS (2,2'-azinobis 3-ethyl benzothiazoline-6-sulfonic acid radical) scavenging assay indicated that all the extracts possess significant free radical scavenging activity. The DPPH assay on the extracts show that the ethyl acetate and *n*-hexane extracts possess significantly higher DPPH scavenging activity. While the FRAP assay indicated that anti-oxidant activity increases with the polarity of the extract, linoleic

acid peroxidation assay indicated that all the extracts possess good activity against the radicals. This study, however, co-relates the anti-oxidant potential with the total phenolic and flavonoid levels (35).

In vitro study on silver nano particles synthesized from the plant leaf extract and that of the leaf extract was done to determine their anti-oxidant activity by DPPH assay. The percentage inhibition of DPPH was calculated using the formula,

Scavenging % = (A0-A1)/A0 X 100, where A_0- absorbance of control and A_1 absorbance of sample.

The study revealed that both the nano particle and the leaf extract possess 50% of DPPH radical quenching activity at 60 and 80 µg/ml concentrations respectiviely which was comparable to that of the standard rutin.

The H_2O_2 scavenging activity of the silver nano particles and the leaf extract was studied with ascorbic acid as standard. 50% inhibition was found at concentrations of 30 and 40 µg/ml of the nano particles and the leaf extract respectively.

The reducing activity of the nano particles and the extract was studied by their ability to reduce ferric ions with ascorbic acid as standard. The investigation revealed that the nano particles possess higher reducing activity than the leaf extract with the reducing activity of the nano particles comparable to that of the standard at 300 µg/ml.

The superoxide ion quenching activity was investigated which revealed that at 200 µg/ml, both the nano particles and the leaf extract show 52% and 67% activity respectively compared to the 78% of the standard rutin.

Nitric oxide scavenging assay for testing the free radical scavenging capacity showed that free radical inhibition increases with the concentration and it was found to be 14% and 33% respectively at 250µg/ml (19).

Anti-bacterial activity:

The antibacterial activity of the plant leaf extract in chloroform, ethanol and water was studied against bacterial species such as *Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumoniae, Psuedomonas aeroginosa, Escherichia coli* and *Salmonella typhi* with chloramphenicol as standard. Investigations yielded that the water extract lacked activity against all the six species while the ethanol and chloroform extract showed good inhibition against *Staphylococcus aureus, Psuedomonas aeroginosa, Escherichia coli* and *Salmonella typhi* and less activity against the other two species (26).

Studies have shown that the silver nano particles synthesized from the aqueous extract of leaves possess anti-bacterial activity. The anti-bacterial activity was tested against six different species such as *Escherichia coli, Pseudomonas fluorescence, Bacillus cereus, Salmonella typhi, Staphylococcus aureus* and *Shigella flexineri.* The study revealed that the silver nano particles

show good antibacterial activity against all the six species with the activity comparable to that of the antibiotic streptomycin. At 250µg/ml, clearance zones observed for *E. coli*, *P. fluorescence*, *B. cereus*, *S. typhi* and *S. aureus* were 260.27, 240.37, 140.67, 120.22 and 180.82mm respectivily while streptomycin produced clearance zones of 300.52, 290.26, 270.37, 270.72 and 280.26 mm respectively. At 300 µg/ml, *S.flexineri* produced a clearance zone of 250.52mm comparable to that of streptomycin, 300.24mm (19).

It has been speculated that the anti-bacterial activity of the nano particles is a result of their interaction with the cell membranes, affecting their permeability and respiratory function which ultimately leads to cell lysis (24, 8).

Anti cancer activity:

The cytotoxic activity of the silver nano particles synthesized from aqueous leaf extract was investigated using COLO 205 cancer and MDCK normal cell lines. The nano particle treated COLO 205 cells showed low IC_{50} values of 4 and 3 µg/ml after 24 and 48 hours respectively while the nano particle treated MDCK cells showed high IC_{50} values of 100 and 75 µg/ml after 14 and 48 hours respectively.

COLO 205 cells treated with the nano particle were observed to be unhealthy cells with shapeless morphology and restricted cell spreading pattern. The mechanism of apoptosis was studied AO/EB staining techniques. AO stains the normal healthy cells with green fluorescence while EB stains the apoptotic cells with red florescence due to chromatin condensation and nuclear fragmentation.

Double staining of the treated cells with AnnexinV-Cy3 conjugated with 6-CFDA revealed that during the onset of apoptosis, transport of phosphatidyl serine from inner to outer membrane of the cell which is bound to AnnexinV-Cy3 and 6-CFDA measures the cell viability and produces the green florescence. The treated apoptotic cells bind to both dyes and florescence in both red and green.

The study also showed that when the nano particle treated cells were stained with DCFH-DA, they florescence green due to high levels of ROS which suggest that cell death is due to oxidative stress resulting in apoptosis.

When stained with Rhodamine123, the treated cells emitted green florescence which indicated MMP loss. The MMP loss is an indicator of cell death by apoptosis.

The TUNEL assay performed on the treated cells indicated no necrosis occurring in the dying cells. It was also observed that cell death occurred due to arrest of cell cycle at the G1/S phase of cell cycle.

Theses assays have suggested that cell death by the silver nano particles synthesized from the plant leaf extract is due to apoptosis rather than necrosis (19).

Anti-inflammatory activity:

The LC50 value of ethanolic extract of *A.indicum* was found to be 4 g/kg body weight. Studies revealed that doses of 250, 500 and 750 mg/kg body weight of ethanolic extract of *A.indicum* reduced the oedema volume by 37%, 49% and 65.65% respectively, which was comparable to the standard drug ibuprofen -76.34% (34). The anti-inflammatory activity was due to the presence of flavonoids in the extract, which functions as an anti-inflammatory agent (9).

Analgesic activity:

Eugenol (4-allyl-2-methoxyphenol) isolated from the plant was found to possess good analgesic activity. Administration of 10, 30 and 50 mg/kg body weight of eugenol inhibited acetic acid induced writhing in mice (1).

Hypoglycaemic activity:

Studies have shown that the alcoholic and aqueous extract of *Abutilon indicum* leaves exhibit marked reduction in blood glucose levels by approximately 23% and 27% respectively, whereas the petrol and methanol extract did not possess a significant hypoglycaemic effect (30).

It has been reported that an inhibitory effect on glucose absorption was observed at a concentration of 2.5 and 5mg/ml of the extract compared with the drug glibenclamide. The stimulation of insulin secretion was dose dependent. The reduction of blood glucose by the *A.indicum* extract was partially by stimulating insulin secretion and partially by retarding sugar absorption in the small intestine (15).

Another study revealed that 0.25 and 0.5 g/kg of the extract significantly reduced postprandial plasma glucose, as seen in glibenclamide- treated rats (16). *A.indicum's* crude extract acts as a PPAR gamma ligand and possesses insulin- like properties (31). Adipogenesis was enhanced through PPAR gamma activation by the butanol fraction of the plant extract. *A.indicum* has been used in patients of diabetic neuropathy and found to revert sensory perception and lessen the symptoms significantly (25)

This could be attributed to the combined effect of regeneration of damaged pancreatic beta cells by flavonoids and the stimulation of insulin secretion in beta cells of pancreas by glycosides, which are present in the extract (30). The flavonoids present in the extract protect the cells from oxidative stress mediated cell injury, beneficial to diabetic patients. It was also found that saponins and alkaloids inhibit glucose uptake (6). These chemicals explained the antidiabetic activity of the plant.

Also the antidiabetic activity of *A.indicum* has been attributed to the seven compounds isolated from the plant extract of which 6 of them were identified as beta- sitosterol, oleanolic acid, (24R)-alpha-stigmastane-3,6-dione, daucosterol, 2,6-dimethoxy-1,4-benzoquinone and vanillic acid (18).

Hepatoprotective activity:

A study was carried out to determine the hepatoprotective activity of aqueous leaf extract of the plant against carbon tetrachloride- and paracetamol- induced hepatotoxicity. The LD50 value of the extract was found to be higher than 4g/kg body weight when administered orally to rats.

The study also showed that treatment of rats with carbon tetrachloride and paracetamol increased the levels of serum glutamic oxaloacetate transaminase, serum glutamic pyruvate transaminase, alkaline phosphate, total bilirubin and direct bilirubin and decreased liver glutathione levels. Pretreatment with the extract decreased the levels of serum glutamic oxaloacetate transaminase, serum glutamic pyruvate transaminase, alkaline phosphate, total bilirubin and direct bilirubin and increased liver glutathione levels restoring normalcy. This effect was comparable to that of the standard silymarin.

The mechanism of action of the extract was found to be due to interference with cytochrome P450 which blocked the production of free radicals. It has been speculated that in case of paracetamol induced hepatotoxicity, the hepatoprotective effect of the extract could be due to promotion of glucuronidation (27).

Immuno modulation activity:

"Bala compound" is an Ayurvedic preparation which is used to protect infants from common diseases by stimulating their immune system. One of the major ingredients of this Ayurvedic preparation is *A.indicum*. A clinical study with this compound has confirmed that administration of the compound to neonates resulted in increase in antibody levels such as IgG, IgM and IgA after three and six months of administration (2).

Larvicidal activity:

A study was performed to assess the larvicidal potential of *A.indicum* extract against the third instar larvae of *Culex quinquefasciatus*. The maximum larvicidal activity was observed in the following order: methanol > ethyl acetate > chloroform > hexane extracts. The LC50 values were found to be 204.18, 155.53, 166.32 and 118.58 for hexane, chloroform, ethyl acetate and methanol extracts of the plant. The larval densities reduced by 51.7%, 77.6% and 92% upon treatment of sewage water systems with the plant extract at 24, 48 and 72h respectively (14).

Separation and identification of a new mosquito larvicidal compound, beta- sitosterol, was possible with the help of bioassay guided fractionation of *A.indicum*. The LC50 value of this compound against *Anopheles aegypti, Anopheles stephensi* and *C.quinquefasciatus* was found to be 11.49, 3.58 and 26.67 ppm. Investigations have reported that 80% ethanol extract from the root of *A.indicum* exhibited 57% mortality at 100 g/ml (28).

Another study stated that the highest larvicidal potential of *A.indicum* was present in the petroleum ether extract of the plant, which gave 100% mortality at a concentration of 1000 ppm. The presence of beta- sitosterol in the petroleum ether extract of the plant accounted for it's highest mortality, and the mortality is directly proportional to the concentration of this compound. This study affirmed that petroleum ether extract of *A.indicum* presented effective larvicidal activity compared to other Malvacae plant species extracts (29).

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