



## Phytochemical and Pharmacological Profile of *Abutilon Indicum* L. Sweet : A Review

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### ABSTRACT

*Abutilon indicum* (Linn) family *Malvaceae*, commonly known as Atibala is an important medicinal plant. The whole plant as well as specific part such as root, leaves, and flower is used to treat various health ailments. It is found as a weed in sub-Himalayan tracts, hills up to 1200 m and in hotter parts of India. The plant is found to possess immunodulatory, anticonvulsant, larvicidal, Lipid lowering, diuretic, and anti-ulcer activity. The plant contains mucilage, tannins,  $\beta$ -sitosterol, asparagines, flavonoids, alkaloids, hexoses, n-alkane mixtures (C<sub>22-34</sub>), alkanol, gallic acid and sesquiterpenes. Thus the aim of present review is to provide detailed survey of literature on the phytochemical and pharmacological properties of *Abutilon indicum*.

**Keywords:** *Abutilon indicum*, traditional uses, pharmacognostical, phytochemistry, pharmacological activities.

### INTRODUCTION

Medicinal plants are the nature's gift to human beings to make disease free healthy life. It plays a vital role to preserve our health. India is one of the most medico- culturally diverse countries in the world where the medicinal plant sector is a part of time- honored tradition that is a respected even today. Here, the main traditional systems of medicine include Ayurveda, Unani and Siddha.<sup>1</sup> With the emerging worldwide interest in adopting and studying traditional systems and exploiting their potential based on different health care systems, the evaluation of the rich heritage of traditional medicine is essential<sup>2</sup>. In India different parts of medicinal plants have been used for curing various diseases from ancient times. In this regard, one such plant is *Abutilon indicum*.

The *Abutilon* L. genus of the *Malvaceae* family comprises about 150 annual or perennial herbs, shrubs or even small trees widely distributed in the tropical and subtropical countries of America, Africa, Asia and Australia. Some of the plants belonging to the species are amongst much acclaimed Ayurvedic herbs and in the recent past there has been a renewed scientific interest in exploring the specie<sup>3</sup>.

### Distribution

*Abutilon indicum* (Linn.) Sweet family *Malvaceae* commonly called as 'Country mallow' (English), 'Kanghi' (Hindi) and 'Atibala' (Sanskrit). It is a perennial shrub, softly tomentose and up to 3 m in height. The plant is found in India, Sri Lanka, topical regions of America and Malesia<sup>4</sup>. It is found as a weed in sub-Himalayan tracts, hills up to 1200 m and in hotter parts of India.

### Botanical Description

The leaves are ovate, acuminate, toothed, rarely subtrilobate and 1.9-2.5 cm long. The flowers are yellow

in color, peduncle jointed above the middle. The petioles 3.8-7.5 cm long; stipules 9 mm long; pedicels often 2.5-5 mm long, axillary solitary, jointed very near the top; calyx 12.8 mm long, divided in to middle, lobes ovate, apiculate and corolla 2.5 cm diameter, yellow, opening in the evening. The fruits are capsule, densely pubescent, with conspicuous and horizontally spreading beaks. The stems are stout, branched, 1-2 m tall, pubescent. The seeds are 3-5 mm, reniform, tubercled or minutely stellate-hairy, black or dark brown<sup>5-8</sup>.

**Synonym(s):** *Sida indica* L.,

### Vernacular names of *Abutilon indicum*

Hindi	- Kanghi, Kakahi
English	- Country mallow, Indian mallow
Bengali	- Petari
Malayalam	- Dabi, Uram
Guajarati	- Khapat, Kansi, Dabli
Marathi	- Mudra, Petari
Tamil	-Tutti, Paniara, Hutti
Telugu	-Tutturubenda

### Scientific classification

Kingdom	: Plantae
Order	: Malvales
Family	: Malvaceae
Genus	: <i>Abutilon</i>
Species	: <i>Abutilon indicum</i>

### Traditional Uses

Almost all the parts of Atibala are of medicinal importance and used traditionally for the treatment of



various ailments. The roots of the plant are considered as demulcent, diuretic, in chest infection and urethritis. The infusion of the root is prescribed in fevers as a cooling medicine and is considered useful in strangury, haematuria and in leprosy. The leaves are found to be good for ulcer and as a fomentation to painful parts of the body. The decoction of the leaves is used in toothache, tender gums and internally for inflammation of bladder. The bark is used as febrifuge, anthelmintic, alexeteric, astringent and diuretic. The seeds are used in piles, laxative, expectorant, in chronic cystitis, gleet and gonorrhoea<sup>5, 8, 9, 10</sup>.

### PHARMACOGNOSTICAL STUDIES

A detailed Pharmacognostic study of all the parts of *Abutilon indicum* has been carried out.

#### Root

The root is true, 1.2-1.5 cm in diameter, cylindrical with smooth surface, yellow in colour with strong fragrance and saltish in taste.

Transverse section of root shows undulate in outline, bark 10-15  $\mu$ , periderm 10-12 layered, cortex reduced 150-165  $\mu$ , secondary wood arranged in definite rings, number of rings varies from 3-4, wood 200  $\mu$ , vessel 25-30  $\mu$  in diameter<sup>11</sup>.

The root is true, 0.8-1.6 cm in diameter, cylindrical with smooth surface, yellowish brown in colour, strong fragrance and characteristic taste. Fracture is fibrous in nature. Numerous root hairs are present.

Anatomical investigations of root of *Abutilon indicum* Linn. showed the presence of Cork which is about 6 layers, radially arranged, thin walled, have polygonal, tabular cells; Cortex is Parenchymatous in nature; Medullary rays is 2-3 layered, parenchymatous radially elongated cells; Phloem Consisting of fibers, slightly lignified alternating with sieve tissue; Xylem is present as protoxylem and metaxylem and Consist of Xylem fibers, lignified vessels, little xylem parenchyma; Xylem vessels are lignified<sup>12</sup>.

#### Stem

The stem is yellow in colour, 0.3-0.9 cm in diameter with relative density of about 1.8, soft and flexible in behavior. The longitudinal surface is smooth, yellow on either side with middle white. The bark is epidermal in origin, 0.1-0.2 cm in diameter, flattened, the outer surface is hairy, and greenish to yellow in colour, and the inner surface is smooth, greenish to yellow in color. Fracture is fibrous in nature.

Transverse section of stem shows undulate in outline, unicellular hairs 500-750  $\mu$ , multicellular hairs 100-140  $\mu$  present, former more numerous than latter, unicellular hairs pointed while multicellular hairs blunt, some giant unicellular hairs 1000  $\mu$  present, epidermal cells barrel-shaped, cortex 40-75  $\mu$ , filled with parenchymatous cells 7.5-5.0  $\mu$ , wood 100-150  $\mu$ , vessel 10-15  $\mu$ , pith 650-750

$\mu$ , formed of Parenchymatous cells 40-50  $\mu$ , medullary ray 100-115 $\times$ 25-40 $\mu$ , druses in collenchymatous cells, phloem with prominent fibres, pith with mucilaginous cavity<sup>11</sup>.

The Transverse section of stem have the following characteristic features. The outer region consisted of epidermis and was made up of elongated continuous cells. To the epidermis trichomes were observed which were unicellular, uniseriate in nature. This is rarely seen in this species of plant. The next region was the arrangement of parenchyma cells which were closely packed and were arranged in 8-9 layers. Below this layer there was arrangement of pericyclic fibers. The vascular bundles were arranged radially consisted of 6-7 layers of xylem. Both lignified and nonlignified fibers were observed in this region. The central portion consisted of pith made up of tightly packed parenchyma cells. In between the vascular bundles and pith loosely packed collenchyma cells<sup>13</sup>.

#### Bark

Transverse section of bark shows single layered epidermis having rectangular cells. It is covered with thick and smooth cuticles. The cork contains seven to nine layers of parenchymatous cells. The outermost and inner layers are reddish brown colour and colourless respectively. Phelloderm layer contains one to three layers of radially arranged parenchymatous cells. The bark contains thick walled phloem fibres which are arranged in bundles of 15-18 fibres. The cellulose and lignin present in outer and inner part of each fibres. Each bundle is surrounded by parenchymatous sheath. Phloem parenchyma are thin walled parenchymatous cells. Medullary rays are biseriate in nature having parenchymatous cells. Prisms of calcium oxalate crystals are present abundantly. Cambium strip have 12-14 layers of thin parenchymatous cells. Xylem vessels are 70-180 $\mu$  in diameter with thick, pitted or reticulately thickened walls lignified. Xylem fibres are lignified<sup>14</sup>.

#### Leaf

Evergreen, Base-cordate, stipulate, filiform, petiole 1.5-1.70 cm long, cylindrical, yellowish brown in colour, stellate and hairy. Lamina- simple, cordate, reticulate, crenate, dentate, acute to acuminate base-cordate, surface dull green in colour, minutely stellate, hairy above, glaucous below, glandular hairs present, coriaceous in texture.

Transverse section of leaf shows dorsiventral, covered with stellate, pitcher and flask shaped glandular hairs, 75-100  $\mu$  and 150-250  $\mu$  respectively epidermal cells 15 $\times$ 10  $\mu$  with straight anticlinal walls, stomata anamocytic and amphistomatic with stomatal index 21.5 and 13.32 in abaxial and adaxial surfaces respectively, palisade 100-120  $\mu$ , spongy 50-60  $\mu$ , palisade two layered, distal end of petiole shows isolated collateral vascular bundles arranged in a circle, crystals lie below the vessels 25-40  $\mu$ , parenchymatous tissue seen, druses in spongy<sup>11</sup>.



## PHYTOCHEMISTRY

*Abutilon indicum* has been explored phytochemically by various researchers and found to possess number of chemical constituents.

### Whole plant

The whole plant contains mucilaginous substances and asparagines, saponins, flavonoids, alkaloids, hexoses, n-alkane mixtures (C<sub>22-34</sub>), alkanol as main classes of compounds. Some important constituents reported in the plant are  $\beta$ -sitosterol, vanillic acid, *p*-coumaric acid, caffeic acid, fumaric acid, Abutilon A, (R)-N-(1'-methoxycarbonyl-2'-phenylethyl)-4-hydroxybenzamide, *p*-hydroxybenzoic, galacturonic, *p*- $\beta$ -D-glycosyloxybenzoic and amino acids<sup>15,16</sup>.

The plant *Abutilon indicum* contains of essential oil which mainly consists of  $\alpha$ -pinene, caryophyllene, caryophyllene oxide, endesmol, farnesol, borenol, geraniol, geranyl acetate, elemene and  $\alpha$ -cineole<sup>17,18</sup>.

### Root

From the roots, non – drying oil consisting of various fatty acids viz. linoleic, oleic, stearic, palmitic, lauric, myristic, caprylic, capric and unusual fatty acid having C17 carbon skeleton, sitosterol, and amyirin from unsaponifiable matter were yielded<sup>19</sup>.

### Leaves

The leaves of the plant contain steroids, sapogenins, carbohydrates and flavonoids<sup>20</sup>. Eudesmic acid, ferulic acid and caffeic acid have been isolated from the methanol extract of leaves of the plant *Abutilon indicum*. IR, 1H-NMR, 13C-NMR, mass spectroscopy and chemical methods allowed the identification of these compounds.<sup>21</sup> Flavonoids, Terpenes, Amino acids, Aldehyde, Hydrocarbon, Ketone, Fatty acids and esters were reported for the first time from the ethanolic leaf extract of *Abutilon indicum* by using gas chromatography coupled to mass spectrometry (GC-MS)<sup>22</sup>.

### Flower

Seven flavonoids compounds: luteolin, chrysoeriol, luteolin 7-O-beta-glucopyranoside, chrysoeriol 7-O-beta-glucopyranoside, apigenin 7-O-beta-glucopyranoside, quercetin 3-O-beta-glucopyranoside, quercetin 3-O-alpha-rhamnopyranosyl (1 --> 6)-beta-glucopyranoside, were isolated and identified from the flowers of *Abutilon indicum* (L.) Sweet (Malvaceae).<sup>23</sup> Two sesquiterpene lactones i.e. alantolactone and isoalantolactone have been first time reported<sup>24</sup>.

### Fruits

Fruits contain flavonoids and alkaloids<sup>25</sup>.

### Seed

A water soluble galactomannan has been isolated from the seeds of *Abutilon indicum* containing D-galactose and D-mannose in 2:3 molar ratio<sup>26</sup>. The seed oil of the plant

affords *cis* 12, 13-epoxyoleic (vernolic) acid, 9, 10-methylene octadec-9-enoic (sterculic) acid, as well as 8, 9-methylene-heptadec-8-enoic (malvalic) acid<sup>27</sup>. TLC-GLC studies of seed oil revealed the presence of high amount of unsaturated acids. Stearic acid and palmitic acid were the principal component from the saturated acids. Raffinose as a prime sugar component was found in seed<sup>28</sup>. Amino acid profile of seed proteins (31%) contains threonine, glycine, serine, glutamine, lysine, methionine, isoleucine, proline, alanine, cysteine, tyrosine, phenylalanine, leucine, asparagine, histidine, valine, arginine<sup>29</sup>.

### Aerial Part

The aerial part of the plant contain n-alkane mixture, an alkanol fraction and  $\beta$  – sitosterol; fumaric, *p*-coumaric, vanillic, caffeic, and *p*-hydroxybenzoic, *p* -  $\beta$  -D-glycosyloxybenzoic acids, and gluco-vanilloyl glucose, fructose, aspartic acid, histidine, threonine, serine, and leucine. Galactose and galacturonic acids are present in mucilage fraction. Saponins, flavonoids, and alkaloids are present in shoot and flowers<sup>16</sup>.

## ANTIMICROBIAL ACTIVITY

Methanolic extracts of various parts of *Abutilon indicum* were tested for their ability to inhibit the aetiological agents of dermal fungal infections in humans. The screening for the antimycotic activity was performed by testing Minimum Inhibitory concentration and Disc diffusion method. Thin layer chromatographic analysis of plant extract used to purify the flavonoid content of plant parts. Quercetin present in these extracts was separated. Methanolic extract of leaves of *Abutilon indicum* shows remarkable antifungal activity against *Trichophyton rubrum*<sup>30</sup>.

The anti bacterial activity of the extracts prepared from the dried leaves of *Abutilon indicum* (L.) Sweet was carried using agar-well diffusion method against both gram positive and gram negative microorganisms. Among all the extracts the ethanolic extract of the leaves showed significant (P<0.001) antibacterial activity comparable to the standard penicillin potassium and streptomycin sulphate against selected gram positive and gram negative bacteria.<sup>31</sup>

The antimicrobial activity of petroleum ether, Chloroform and Methanol extract obtained from *Abutilon indicum* leaf was tested against Gram-negative bacteria like *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Agrobacterium tumefaciens* and two strains of Gram-positive bacteria *Staphylococcus aureus* and *Bacillus subtilis*, using agar well diffusion method. The highest antibacterial potentials were observed against *Staphylococcus aureus* (18.72±0.01mm), *Pseudomonas aeruginosa* (17.49±0.14mm), *Klebsiella pneumoniae* (17.15±0.03) and less activity found against *Escherichia coli* (9.75±0.13). The results showed that the petroleum ether and methanol extract of *Abutilon indicum* has potent antibacterial activity against the pathogenic



strains of *pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumoniae*.<sup>32</sup>

Eudesmic acid, ferulic acid and caffeic acid have been isolated and identified first time from the methanol extract of leaves of *Abutilon indicum*. The isolated compounds were evaluated for antibacterial activity against medicinally important bacteria viz. *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* and for antifungal activity against *Candida albicans* and *Aspergillus niger*. The antimicrobial activity was performed by agar diffusion assay (Disc diffusion method). The compound Eudesmic acid showed maximum inhibition zone for *E. coli* whereas the compound ferulic acid showed maximum inhibition zone for *Pseudomonas aeruginosa*. None of the three compounds of methanol extracts could inhibit *Bacillus subtilis*. But *Pseudomonas aeruginosa* was the most susceptible bacteria, while *Bacillus subtilis* was the most resistant bacteria which was comparable to that of standard Chloramphenicol. Compound ferulic acid and caffeic acid showed good antifungal activity against *Aspergillus niger* and *Candida albicans* which was comparable to that of standard Amphotericin-B.<sup>21</sup>

The methanolic leaf extracts were subjected to antimicrobial analysis against pathogenic microbes. The overall antibacterial analysis revealed maximum against *Bacillus subtilis* and minimum against *Salmonella typhi* and anti fungal activity was maximum against *Aspergillus niger* and minimum against *Aspergillus fumigatus*.<sup>33</sup>

## PHARMACOLOGICAL ACTIVITIES

### Diuretic activity

The diuretic effect of *Abutilon indicum* Linn. seed extract was evaluated in rats. Diuretic and Natriuretic activities were carried out by administration of normal saline along with the treatment modules. The volume of urine (in ml) and the Na<sup>+</sup> and K<sup>+</sup> content in the urine were measured. The extract at 200 and 400 mg / kg, produced significant diuresis and increased sodium elimination but not potassium.<sup>34</sup>

### Antioxidant activity

Antioxidant activity of methanolic extract of *Abutilon indicum* leaves was investigated for its free radical scavenging activity by determining the nitric oxide and superoxide radical scavenging activity. Maximum scavenging of nitric oxide and superoxide radical found were 28.74 % and 49.62 % respectively at 250 µg/ml concentration.<sup>35</sup>

A *in-vitro* studies were carried out to study the comparative properties of total polyphenol content quantified by Folin-Ciocalteu method and its free radical scavenging (antioxidant) activity by DPPH (2, 2-diphenyl-1-picryl hydrazyl) in methanolic, Hydro-alcoholic and aqueous extracts of the *Abutilon indicum* Stem. Results showed that different extracts of the *Abutilon indicum* stem exhibited a significant phenolic content with

promising free radical scavenging effect of DPPH in a concentration dependant manner. The aqueous extracts of stem showed a more total phenolic content and possessed a significant scavenging activity<sup>36</sup>.

The *in-vivo* antioxidant potential of ethanolic extract of *Abutilon indicum* was evaluated against CCl<sub>4</sub> induced toxicity in rats. Animals were treated with plant extract for 7 days and then toxicity was induced with a single CCl<sub>4</sub> intraperitoneal injection. Pre-treatment with 500 mg/kg (p.o.) of ethanolic extract of *Abutilon indicum* improved the glutathione, SOD, catalase, and peroxidase levels significantly as compared to control group.<sup>37</sup>

The anti oxidant activity of leaf extracts of *Abutilon indicum* L.(Malvaceae) was evaluated to explore new bioactive compatibles with least associated side effects. The methanol extracts was prepared and screened for *in vitro* by using FRAP (Ferric Reducing antioxidant Power). The reducing power of methanolic leaf extract was markedly increase by increasing concentration. The results indicated a strong antioxidant activity<sup>38</sup>.

The total protein profiling as well as antioxidant activities of the leaves extracts of *A. indicum* was evaluated. The results demonstrated that the total 12.5±3.6mg of protein was found per gm of fresh leaves. The molecular weight of the most abundant protein of the leaves was approximately 50.8 kDa. The results also indicated that the plant has the enzymatic components associated with SOD, CAT, PX make possible to defense against ROS. The antioxidant activity in *Abutilon* species may be due to the higher phenolic content<sup>39</sup>.

### Hypoglycemic activity

The Hypoglycemic activity of *Abutilon indicum* leaf extracts in rats was studied. Alcohol and water extracts of *Abutilon indicum* leaves (400 mg/kg, p.o.) showed significant hypoglycemic effect in normal rats 4 h after administration (23.10% and 26.95%, respectively)<sup>40</sup>.

### Larvicidal activity

Larvicidal activity of crude hexane, ethyl acetate, petroleum ether, acetone and methanol extracts of *Abutilon indicum* were assayed for their toxicity against the early fourth-instar larvae of *Culex quinquefasciatus*. All extracts showed moderate larvicidal effects; however, the highest larval mortality was found in petroleum ether extract of *Abutilon indicum*. Bioassay-guided fractionation of *Abutilon indicum* led to the separation and identification of a beta-sitosterol as a potential new mosquito larvicidal compound with LC50 value of 11.49, 3.58 and 26.67 ppm against *Aedes aegypti* L, *Anopheles stephensi* Liston and *C. quinquefasciatus* Say (Diptera: Culicidae), respectively. The Results showed that the petroleum ether extract of *Abutilon indicum* may be considered as a potent source and beta-sitosterol as a new natural mosquito larvicidal agent<sup>41</sup>.



### Anti diabetic activity

A study was carried out to evaluate antidiabetic effects of the aqueous extract derived from the Thai *Abutilon indicum* Sweet plant and to explore its effects on intestinal glucose absorption and insulin secretion. Administration of the extract (0.5 and 1 g/kg body weight) in an oral glucose tolerance test led to a significant reduction in plasma glucose levels in 30 minutes after the administration in moderately diabetic rats, as compared with untreated rats ( $P < 0.05$ ), and this was at a faster rate than the use of an antidiabetic drug, glibenclamide. The inhibition of glucose absorption through the small intestine was investigated using an everted intestinal sac. The results showed that the extract at concentrations of 0.156 to 5 mg/mL caused a reduction of glucose absorption in a dose response manner. The maximum response was noted at a dose of 2.5 mg/mL<sup>42</sup>.

### Antiulcer Activity

The antiulcer activity was performed using models such as aspirin+pylorus ligation, ethanol induced and acetic acid induced ulcer model. The effect of the extract on volume of gastric content, pH, total and free acidity using the aspirin+pylorus ligation model were also evaluated. From the result, it was observed that the treatment with *Abutilon indicum* leaf extract significantly reduced the ulcer index ( $P < 0.001$ ) in alcoholic and aqueous extracts compared to that of control group in aspirin+pylorus ligation, alcoholic and acetic acid induced ulcer model at a dose of (400 mg/kg, p. o). Famotidine at a dose of (20 mg/kg) was used as standard drug. The model of gastric acid secretion showed a reduction in volume of gastric content, increased in pH, free and total acidity<sup>43</sup>.

The antiulcer activity of methanol extract of *Abutilon indicum* L. (Family: Malvaceae) leaves was investigated in pylorus ligated and ethanol induced ulceration in the albino rats. Ulcer index and percentage inhibition of ulceration was determined for ethanol induced ulcer model. Ranitidine at 50 mg/kg was used as the standard drug. Pretreatment of methanol extract of *A. indicum* leaves showed significant ( $P < 0.05$ ) decrease in the gastric volume, total acidity and free acidity. However, pH of the gastric juice was significantly ( $P < 0.05$ ) increased only at higher dose, 500 mg/kg. It showed also significant ( $P < 0.05$ ) decrease in number of ulcers and ulcer score index in pylorus ligation and ethanol induced ulceration models.<sup>44</sup>

### Lipid lowering activity

Lipid lowering effect of the successive extracts of the leaf of *Abutilon indicum* (L.) was evaluated in triton and diet induced hyperlipidemic models of wistar albino rats. The ethanolic and water extract at 400 mg/kg dose levels inhibited the elevation in serum cholesterol and triglyceride levels on Triton WR 1339 administration rats. The extracts at the same dose level significantly attenuated the elevated serum total cholesterol and

triglycerides with an increase in high-density lipoprotein cholesterol in high-fat diet-induced hyperlipidemic rats<sup>45</sup>.

### Analgesic activity

Bioactivity guided isolation of *Abutilon indicum* yielded eugenol [4-allyl-2-methoxyphenol], which was found to possess significant analgesic activity. At doses of 10, 30, and 50 mg/kg body weight, eugenol exhibited 21.30 ( $p < 0.05$ ), 42.25 ( $p < 0.01$ ) and 92.96% ( $p < 0.001$ ) inhibition of acetic acid induced writhing in mice. At a dose of 50 mg/kg body weight, eugenol showed 33.40% ( $p < 0.05$ ) prolongation of tail flicking time determined by the radiant heat method<sup>46</sup>.

The analgesic potential of various extracts of the root of *Abutilon indicum* Linn was evaluated. The powdered root (900 g) was subjected to successive solvent extraction, with solvents in increasing order of polarity, namely, petroleum ether (60 - 80°C), methanol, and ethanol, using the soxhlet apparatus for 72 hours. The marc was extracted by cold maceration for 72 hours, to obtain a water-soluble extract. The peripheral analgesic activity was studied using acetic acid-induced writhing method in Swiss albino mice (20 - 30 g), while the central analgesic activity was evaluated by the tail flick method and the tail immersion method. Results indicated that all the tested extracts, except the methanol extract, exhibited significant analgesic activity in both animals' models. Petroleum ether extract showed higher analgesic activity. The activity may be related to the central mechanism or may be due to the peripheral analgesic mechanisms. Thus study authenticated the traditional use of *Abutilon indicum*.<sup>47</sup>

### Wound healing activity

The ethanolic extract of *Abutilon indicum* was studied for wound healing activity using incision, excision and dead space wound models in albino rats. This extract at a dose of 400-mg/kg showed significant increase in wound contraction rate, skin breaking strength, granuloma strength and dry granuloma weight. Moreover, the decrease in epithelisation period was observed as compared to control and standard. This pro-healing was dedicated to increase in collagenation deposition as well better alignment and maturation.<sup>48</sup>

### Anti-convulsant activity

Anticonvulsant activity of *Abutilon indicum* leaf extracts was investigated using Pentylene tetrazole (PTZ) and Maximum Electro Shock (MES) induced convulsions in wistar rats. In PTZ induced convulsions, 100 mg/kg and 400 mg/kg of ethanolic extract was found to increase the onset of clonic convulsions and decreased onset of tonic seizures and thus exhibited a significant anti-convulsant effect. In MES induced seizures, 100 mg/kg and 400 mg/kg of ethanolic as well as aqueous extracts showed significant protective effect by increasing the onset of clonic convulsion time and decreasing extensor time as compared to control group. This anticonvulsant effect

was attributed to linoleic acid and/or flavonoid constituents present in the extracts<sup>49</sup>.

### Anti-estrogenic activity

The anti-estrogenic effect of methanolic extracts of *Abutilon indicum* on uterotrophic and uterine peroxidase activities in ovariectomized rats was studied. This extract was found to cause significant suppression of enzyme activity as well as uterotrophic response induced by estradiol, whereas in the group, not treated with estradiol, a marginal stimulation in peroxidase activity was observed. These changes in peroxidase activity suggested that *Abutilon indicum* must be a highly potent estrogen antagonist with an extremely low degree of estrogenicity<sup>50</sup>.

### In-vitro anti arthritic activity

Water soluble extract of *Abutilon indicum* (Linn.) was studied by testing three in-vitro parameters: protein denaturation, membrane stabilisation and protease inhibition. *Abutilon indicum* at doses (100 and 250 mcg/ml) provided significant protection against denaturation of proteins and hypotonic saline induced RBC membrane damage. It also exhibited significant anti-protease activity. This finding justifies its usefulness in management and treatment of inflammation associated diseases like arthritis<sup>51</sup>.

### Anti-Arthritic Activity

The various extracts of *Abutilon indicum* were investigated for its anti-arthritic activity in In-vitro studies in male albino rats. The evaluation of anti-arthritic activity was carried out using Freund's adjuvant induced arthritis model. Methotrexate (0.75 mg/kg bw) was used as standard drug. The methanolic extract of *Abutilon indicum* exhibited significant anti-arthritic activity. Treatment with *Abutilon indicum* 400 mg/kg showed significant reduction ( $P < 0.01$ ) in paw volume on both 7th and 14th day. Reference standard Methotrexate also showed similar result in this regard. *Abutilon indicum* 100 and 200 mg/kg were found to be insignificant in reducing paw volume<sup>52</sup>.

### Anti-inflammatory activity

Anti-inflammatory action of *Abutilon indicum* (L.) Sweet leaves by HRBC membrane stabilization technique were investigated. The ethanolic, chloroform and aqueous extracts of the leaves were screened for anti-inflammatory activity. They have taken the prevention of hypotonicity induced HRBC membrane lysis as a measure of anti-inflammatory activity. All Three fractions showed a biphasic effect on the membrane stabilization. Their activities were found to be comparable to that of standard drug diclofenac sodium. However their activities decreased with time. The extracts were supposed to be act either by inhibiting the lysosomal enzymes or by stabilizing the lysosomal membrane<sup>19</sup>.

The ethanolic extract of the whole plant of *Abutilon indicum* L. was evaluated for its anti-inflammatory activity

at doses 250, 500 and 750 mg kg<sup>-1</sup> using the carrageenan-induced paw oedema in healthy Wistar albino rats. Results of in vivo activity led to the conclusion that the ethanolic extract of *A. indicum* showed predominantly significant activity in a dose-dependent manner, which is comparable to the reference standard ibuprofen. The results prove the traditional use of plant in the treatment of inflammation<sup>53</sup>.

### Anti-diarrhoeal activity

Leaf extracts of *Abutilon indicum* were evaluated for anti-diarrhoeal activity by gastro-intestinal motility, castor oil-induced diarrhoea and prostaglandin E<sub>2</sub>- induced enteropooling in rats wherein the methanolic and aqueous extracts showed significant antidiarrhoeal activity in castor oil-induced diarrhoea and prostaglandin E<sub>2</sub>- induced diarrhoea. These extracts were reported to reduce diarrhoea by inhibiting intestinal peristalsis, gastrointestinal motility and PGE<sub>2</sub> induced enteropooling<sup>54</sup>.

### Immunodulatory activity

The ethanolic and aqueous extract of leaves of *Abutilon indicum* was administered orally at the dosage levels of 200 mg/kg/day and 400 mg/kg/day body weight in mice. The assessment of immunodulatory activity on specific and non-specific immunity were studied by hemagglutination antibody (HA) titer, delayed type hypersensitivity (DTH), neutrophil adhesion test and carbon clearance test. Oral administration of *Abutilon indicum* showed a significant increase in the production of circulating antibody titre in response to sheep red blood cells (SRBCs). The study demonstrated that *Abutilon indicum* triggers both specific and non-specific responses to a greater extent<sup>55</sup>.

### CONCLUSION

The extensive survey literature reviewed that *Abutilon indicum* Linn, is an important medicinal plant with diverse pharmacological spectrum. Lot of pharmacological studies have been carried out with extract of the different parts of the plant. The plant is widely used in traditional medicinal system of India and has been reported to possess hepatoprotective, anti-inflammatory, lipid lowering, antifungal, wounds healing and antibacterial properties. The whole plant contains mucilaginous substances and asparagines. Saponins, flavonoids, alkaloids, hexoses, n-alkane mixtures (C<sub>22-34</sub>), alkanol. The present review summarizes some important pharmacological studies on *Abutilon indicum* and phytochemical investigations and isolated principles from them, which can be investigated further to achieve lead molecules in the search of novel herbal drugs. Due to medicinal properties there is enormous scope for future research on *Abutilon indicum* and further clinical and pharmacological investigation should be conducted to investigate unexploited potential of this plant.

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