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PHARMACOGNISTIC AND PHARMACOLOGICAL ASPECT OF ABUTILON INDICUM LINN: A REVIEW

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ABSTRACT

Abutilon indicum Linn. (Malvaceae) is a shrub distributed throughout India. The various parts of the plant (leaves, roots, seeds and seed oil) are widely used by various tribal communities and forest dwellers for the treatment of variety of ailments. The plant contains mucilage, tannins, β-sitosterol, asparagines, flavonoids, alkaloids, hexoses, n-alkane mixtures, alkanol, gallic acid and sesquiterpenes as major phytoconstituents. *Abutilon indicum* has several activity reported as antiinflammatory, antiproliferative, anti-arthritic, analgesic, sedative, antioxidant, antimicrobial, hepatoprotective, antidiabetic, anticancer, anti-diarrhoeal, anticonvulsant, larvicidal, wound healing, antiasthmatic, diuretic, immunomodulatory and anti-estrogenic activity. The aim of present review is to provide detailed survey of literature on the phytochemical and pharmacological properties of Abutilon indicum.

KEYWORDS: Abutilon indicum, Phytochemical, Flavonoids.

INTRODUCTION

Since ancient time, plant- based product has been used for health care, search is continuing for new plant material and their interaction with biological system.[1] According to World Health Organization report, about 80% of the population, mostly in developing countries still depends on traditional medicinal system for their primary health care. India is one of the twelve mega-biodiversity centers with 4 hot spots of biodiversity.[2] Over the last decade there has been a growing interest in drugs of plant origin in contrast to the synthetics that are

regarded as unsafe to human and environment.[3] 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.[4] The *Abutilon indicum* under the family malvaceae includes 75 genera and 1000 species mostly confined to the tropical and sub-tropical regions of the world. In India the family is represented by 22 genera and about 110 species occurring mostly in the warmer part.[5] *Abutilon indicum* (Linn) is an important medicinal plant used in our traditional system of medicine to treat various health aliments.[6] The plant is very much used in Siddha medicines. All the parts of plant have medicinal uses.[7] The various secondary metabolites such as phenols, alkaloids, and flavonoids are found in this plant, saponins have an enormous significance in pharmaceutical industry.[8] The present review is on *Abutilon indicum* (Linn.) are useful for the phytochemists, pharmacologists, clinicians, researchers, scientists and toxicologists for future study.

DISTRIBUTION

*Abutilon indicum (*Linn.) 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. It is found as a weed in sub-Himalayan tracts, hills up to 1200 m and in hotter parts of India.[9]

BOTANICAL DESCRIPTION[10]

Abutilon indicum Linn

Abutilon indicum Linn. is greyish-tomentose undershrubs, reaching 1 m or more in height. Leaves broadly ovate or ovate-lanceolate or sub-orbicular, velvety on both the surfaces, margins dentate; petiolate. Flowers yellow or orange-yellow, solitary, axillary. Carpels 10-25, reniform, dark brown, with minute scattered, stellate hairs. 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.[11]

Abutilon indicum Linn.

Synonyms: *Abutilon indicum* G. Don.

Taxonomic Classification

Kingdom : Plantae

Class : Magnoliopsida

Order : malvales

Family : malvaceae

Genus : *Abutilon*

Species : *indicum*

Vernacular name

English : Indian mallow

Hindi : Kanghi

Bengali : Badela

Sanskrit : Kankatika, Rsyaprokta

Marathi : Mudra, Petari

Telgu : Tutturubenda

Oriya : Pedipidika

Tamil : Tutti, Thuthi

Ayurvedic properties

Rasa : Madhura

Guna : Snigdha

Veerya : Sita

Vipaka : Madhura

Karma : Balya, Vatahara, Vrsya, Grahia

TRADITIONAL USES

Leaves are cooked and eaten for bleeding piles. Their extract is used as a diuretic, demulcent and as an emollient fomentation; along with ghee as a remedy for diarrhoea. Decoction of leaves used as mouthwash in toothache and tender gums, also useful in gonorrhoea, inflammation of bladder and for enema and vaginal infection. The leaves are also applied on wounds and ulcers.[12] Bark is used as astringent and diuretic.[13] Flowers are eaten raw. They are reported to be employed as an application to boils and ulcers. The powdered flowers are eaten with ghee as a remedy in blood vomiting and in cough. Seeds are considered laxative in piles, used in treating cough and are also distinctly useful in gonorrhoea, gleet and chronic cystitis. Root is used as demulcent and diuretic, prescribed in fever, chest infection and urethritis.[14]

PHARMACOGNOSTICAL STUDIES

1. Root

The root is a tap root carrying several lateral rootlets, yellowish brown in colour, cylindrical in shape, odourless with mucilaginous taste. It measures 6-11cm in length and 0.5-1cm in diameter. It is thick, woody with a longitudinally wrinkled surface and a fibrous fracture [15]. Transverse section of root shows a thin cork of 4-7 or more tangentially elongated rectangular cells, cork cambium, single layered, and at the lenticel regions followed by 2-3 layers of secondary cortex of thin-walled, almost cubical or rectangular cells, containing small clusters of calcium oxalate in most of cells, phellogen followed by 3-4 layers of thin-walled cells of cortex, some cells of cortex which are above the conical strands of bast, crushed, small starch grains, 6-9 μ in diameter, present in some of the cells , phloem forms the major portions of bark and present as conical strands with their bases towards the wood and with dilate distal ends of the primary medullary ray in between them, fibres, present in groups of 10-12 in these conical strands, in tangential rows, alternating with thin-walled phloem elements, towards wood fibre groups, element in between the fibres mostly consists of phloem parenchyma.[6]

2. Stem

The stem is erect, cylindrical, green in colour with monopodial branching having internodes of 0.5-7 cm in length. Many hairs cover the stem and lateral branches. The stem measures 0.5–1 m in length and 0.2-1 cm in diameter. It has a mucilaginous taste and faint odour with a fibrous fracture when dry. A transverse section in the upper part of the stem is nearly circular in outline. It shows a similar structure to that of the petiole with a continuous ring of collateral vascular bundle. A transverse section in the lower part of the stem is nearly circular in outline. It exhibits an epidermis carrying non glandular and few glandular hairs, followed by a narrow cortex differentiated into collenchyma and parenchyma, then parenchymatous pericycle interrupted by groups of lignified pericyclic fibers surrounding a continuous ring of vascular tissue with wide parenchymatous pith. Clusters of calcium oxalate and mucilage cells are scattered in the cortex and pith. Secretory cavities containing mucilage are observed in the pith. The cork is not observed.[16]

3. 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 70-180μ in diameter with thick, pitted or reticulatly thickened walls lignified. Xylem fibers are lignified.[17]

4. Leaf

Leaves up to 9 by 5 cm. Chordate, ovate, acuminate toothed, rarely sub trilobate; petioles 3.8-7.5 cm. Long; stipules 9mm. Long linear, acute, deflexed. Pedicles often 2.5-5 long, auxiliary solitary joined very near the top. Calyx 12-8mm. Long, divided to the middle; lobes ovate, apiculate, corolla 2.5cm diameter, yellow, opening in the evening. Staminal tube hairy at the base; filaments long. Carples usually 15-20 longer than the calyx, with a distinct small acute point, hairy, ultimately shining dark brown seeds brown, black, densely and minutely scrobiculate. [18] T.S. of Abutilon leaf consists of midrib and lamina. The midrib consists of single row ovoid short cells the outer cell wall contains cuticle and three different types of trichomes (stellate type, uniseriate multicellular and multicellular multiseriate glandular trichome). The cortex is several cell rows parenchymatous cells in abaxial side of the midrib but in adaxial side the cortex cells are consists of 3-4 rows of angular collenchyma and 2-3 rows of parenchyma cells. The parenchyma cells are containing druce type of calcium oxalate crystals. The vascular bundle consist of phloem and xylem the xylem surrounded by phloem. Phloem cell are several rows with phloem fibres. Phloem parenchyma cell also contains druce type calcium oxalate crystals. Each rows of xylem cells are differentiated with xylem parenchyma. Xylem parenchyma cells containing, simple ovoid starch grains.[6]

5. Flowers

Flowers are solitary, axillary and pedicellated. They are yellow in colour, odourless, mucilaginous in taste with hairy pedicels. They measures 1-2.2 cm in length and 0.9-2 cm in diameter. They are hermaphrodite, actinomorphic, hypogenous, pentamerous and ebracteate. A transverse section in the flower shows a hairy calyx, followed by a corolla, an androecium

of many stamens and each anther lobe consists of one pollen sac containing numerous spiny pollen grains and a gynoecium.[6,16]

CHEMICAL CONSTITUENTS OF *ABUTILON INDICUM*

1. Whole plant

Mucilaginous substances, asparagines. saponins, flavonoids, alkaloids, hexoses, nalkane mixtures (C_{22-34}), alkanol , β-sitosterol, vanillic acid, p-coumaric acid, caffeic acid, fumaric acid, abutilon A, (R)-N-(1'-methoxycarbonyl-2'phenylethyl)-4-hydroxybenzamide, phydroxybenzoic, galacturonic p-β-D- glycosyloxybenzoic and amino acids.[19]

2. Root

Linoleic, oleic, stearic, palmitic, lauric, myristic, caprylic, capric and unusual fatty acid having C_{17} carbon skeleton, sitosterol, and amyrin.[19]

3. Leaves

Steroids, sapogenins, carbohydrates and flavonoids. eudesmic acid, ferulic acid and caffeic acid, terpenes, amino acids, aldehyde, hydrocarbon, ketone, fatty acids and esters.[20]

4. Flower

Flavonoids -luteolin, chrysoeriol, luteolin 7-O-beta glucopyranoside chrysoeriol 7-O-betaglucopyranoside, apigenin 7-O-beta- glucopyranoside, quercetin 3-O-beta-glucopyranoside.[19,20]

5. Fruits

flavonoids and alkaloids.

6. Seed

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, Stearic acid , palmitic acid threonine, glycine, serine, glutamine, lysine, methionine,isoleucine, proline, alanine, cystenine, tyrosine,phenylalanine, leucine, aspargine, histidine, valine, argininine.[20]

7. Aerial Part

n-alkane mixture, an alkanol fraction and β – sitosterol; fumaric, p- coumaric,vanillic, caffeic, and p-hydroxybenzoic, p - β – Dglucosyloxybenzoic 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.[19,20]

REPORTED PHARMACOLOGICAL ACTIVITIES OF ABUTILON INDICUM

1. Antidiabetic activity

Hypoglycemic activity of methanolic leaf extract of *Abutilon indicum* was investigated for hypoglycaemic effect in normal and streptozotocin-induced diabetic rats. The results suggested that the extract of *Abutilon indicum* would be effective for lowering and suppressing elevation of blood glucose level. 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. 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 ‹b.05), and this was at a faster rate than the use of an glibenclamide, antidiabetic drug. The inhibition of glucose absorption through the small intestine was investigated using an everted intestinal sac. The results demonstrated that the extract at concentrations of 0.156 to 5 mg/mL caused a reduction of glucose absorption in a dose response manner. The height response was noted at a dose of 2.5 mg/mL. The promotion of the extract on insulin secretion was confirmed by incubating β cell of pancreatic islets and INS-1E insulinoma cells with the extract at 1 to 1000 μg/mL. These results suggest that the aqueous extract from the A indicum plant has antidiabetic properties, which inhibited glucose absorption and stimulated insulin secretion. Phytochemical screening also revealed that the extract contained flavonoids, alkaloids, tannins, saponins and glycosides that could account for the observed pharmacologic effects of the plant extract.[21]

2. 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. 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^{-1} 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.[22,23]

3. Antioxidant Potential and Radical Scavenging Effects

Antioxidant activity of methanolic extract of A. 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. [24] *A. indicum L.* (Malvaceae) and A. *muticum* DC. (Malvaceae) are traditional medicinal herbs used for anthelmintic, hepatoprotective, analgesic and hypoglycemic properties. These effects may be correlated with the presence of antioxidant compounds. Extracts from the aerial parts and roots of both species were prepared and evaluated for their total antioxidant capacity (TAC), total phenolic content, and total flavonoid content. The Trolox equivalent antioxidant capacity (TEAC) of all the extracts of both plants was found, employing ABTS and FRAP assays. TEAC values ranged from 3.019 to 10.5µM for n-hexane and butanol fractions of A. indicum and from 2.247 to 14.208µM for n-hexane and butanol fractions of Abutilon muticum respectively, using the ABTS assay. The reaction kinetics with this free radical indicated the presence of both slow reacting and fast reacting antioxidant components in the extracts of both plants. The antioxidant/radical scavenging capacity of the extracts was found to be a dose dependent activity. The results obtained in the present study indicate that both Abutilon species are potential sources of natural antioxidants.[25]

4. Anthelmintic and antibacterial activity

Chloroform, ethanol and aqueous extracts of the leaves of *A. indicum* were investigated for antibacterial activity against *Staphylococcus aureus, Bacillus subtilis, Klebsiella pneumoniae, Salmonella typhi, Escherichia coli and Pseudomonas aeruginosa*. The results showed prominent antibacterial activity against the tested microbial pathogens. The antimicrobial activity of ethanol extract ultra-sonic bath assisted obtained from *A. indicum* steam was tested against Gram-negative bacteria like *Staphylococcus aureus, Bacillus subtilis,* Escherichia *coli*

using disc diffusion assay method. The results showed prominent antibacterial activity against the tested microbial pathogens. 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. 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), *Pseudomoas aeruginosa (*17.49±0.14mm*). Klebsiella pneumonia* (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 pneumonia*.[26,27]

5. Anti-Asthmatic Activity

This study reported the effectiveness of powder of dried aerial parts of *Abutilon indicum* in decreasing the severity of commonly observed symptoms of bronchial asthma i.e. cough, chest tightness, wheezing and dyspnoea. It was also demonstrate to significantly increase the pulmonary function measured as forced vital capacity (FVC), forced expiratory volume in 1 Sec (FEV1) and peak expiratory flow rate (PEFR) in patients having mild to moderate bronchial asthma. In another study, methanolic extract inhibited experimentally induced rat peritoneal mast cell degranulation and edema formation. The significant reduces in carrageenan induced rat paw edema at the dose of 250 and 500 mg/kg, p.o. indicated anti inflammatory activity and this activity was postulated towards the anti-asthmatic effect.[28]

6. Hepatoprotective activity

The aqueous extract of the leaves of *A. indicum* demonstrated significant hepatoprotective activity at 100 and 200 mg/kg dose levels in CCl_4-treated rats. The blood samples were collected and the serum was estimated for SGOT [serum aspartate aminotransferase], SGPT [serum alanine aminotransferase], SAP (serum alkaline phosphatase) and total bilirubin

content. CCl_4-induced changes were significantly reduced in the *A. indicum*-treated animals.[29]

7. Immunomodulatory 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 heamagglutination 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.[30]

8. Cytotoxic and Antimicrobial Activity

The investigation was conducted with crude methanolic extract of leaf of *A. indicum* for its cytotoxic and antimicrobial activity. Antimicrobial activity of the extract was evaluated against various Gram-negative, Gram-positive bacteria and fungi using disk diffusion technique. For cytotoxic activity, brine shrimp lethality bioassay was performed to estimate LC_{50} values. The average zone of inhibition produced by carbon tetrachloride extract was found 7-10 mm at a concentration of 400µg/disc. The chloroform extract exhibited no antibacterial activity except *Sarcina lutea* (8.4 mm). In brine shrimp lethality bioassay,LC_{50} obtained from the best-fit line slope were 0.419, 3.01, 5.62, 1.51, and 11.20 µg/ml for positive control (vincristine sulfate), n-hexane, carbon tetrachloride, chloroform and aqueous fraction respectively. The cytotoxicity exhibited by chloroform soluble fraction of methanol extract was promising. The carbon tetrachloride extract showed mild to moderate antimicrobial activity.[31,32]

9. 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 7^{th} 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.[33]

10. Anticonvulsant activity

The present studies reveal that anticonvulsant activity 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 anticonvulsant effect. In MES induces 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.[34]

11. Anti-diarrhoeal activity

Leaf extracts of *Abutilon indicum* were evaluated for antidiarrhoeal activity by gastro intestinal motility, castor oil induced diarrhoea and prostaglandin E2- induced enteropooling in rats wherein the methanolic and aqueous extracts showed significant antidiarrhoeal activity in castor oil-induced diarrhoea and prostaglandin E2- induced diarrhoea. These extracts were reported to reduce diarrhoea by inhibiting intestinal peristalsis, gastrointestinal motility and PGE2 induced enteropooling.[35]

12. Anti-estrogenic activity

The anti-estrogenic effect of methanolic extracts of *Abutilon indicum* on uterotropic and uterine peroxidise activities in ovariectomized rats was studied. This extract was found to cause significant suppression of enzyme activity as well as uterotropic 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.[36]

13. Diuretic activity

Diuretic activity *of Abutilon indicum* Linn (Sweet) seed extract show the results stated that extract at 200 and 400 mg/kg, produced significant diuretic and natriuretic effect but not a potassium sparing effect.[37]

14. Lipid Lowering Activity

The ethanolic and water extract at 400mg/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 dietinduced hyperlipidemic rats. The lipid lowering activity of the Et OH and aqueous leaf extracts of *A. indicum* may be attributed to the phytoconstituents present, such as triterpenoids, flavonoids, tannins, glycosides, and saponins in it, as reported for other plant extracts. Saponin derived from *Medicago sativa* were reported to reduce blood cholesterol by competing with cholesterol at binding sites or interfering with cholesterol biosynthesis in the liver.[38]

15. 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.[39]

16. Cardioprotective Activity

The ethanolic extract of the roots obtained from A. indicum *(Malvaceae)* was evaluated for protection against Isoproterenol (150 mg/kg body wt, s.c) induced myocardial infarction in male Wistar rats. Isoproterenol induced rats showed significant elevation in the levels of serum marker enzymes such as Creatinine Kinase- MB, Lactate dehydrogenase (LDH), Aspartate transaminase (AST) and Alanine transaminase (ALT) with significantly increased lipid peroxides and significant decrease in antioxidant parameters viz., Super oxide dismutase (SOD), Catalase (CAT) and Glutathione peroxidase (GPx) in heart homogenate and also increased serum uric acid level. Oral pretreatment with ethanolic root extract of A. indicum (100 mg/kg body wt) daily for a period of 28 days, reduced significantly the elevated serum marker enzymes and lipid peroxidation and elevated the levels of SOD, CAT and GPx in the heart homogenate and decreased serum uric acid level. Histopathological observation also

revealed a marked protection by the extract in myocardial necrotic damage. Our results show that treatment with ethanolic root extract of A. indicum (100 mg/kg body wt) was safe and highly effective in preventing cardiovascular dysfunction in rats, possibly due to antioxidant property as revealed by the amelioration of histopathological changes and biochemical markers of cardiac tissue damage. However, ethanolic root extract of A. indicum (500 mg/kg body wt) was found to produce myocardial injury on its own and failed to reverse the Isoproterenol induced myocardial injury.[40]

17. 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.[28]

CONCLUSION

Abutilon indicum is a huge phytochemical reservoir of various biologically active phytoconstituents as carbohydrates, steroids, glycosides, flavonoids, tannins and Phenolic compounds. These compounds reported against various diseases like hepatoprotective, wound healing, immunomodulatory, analgesic, antimalarial, antimicrobial, hypoglycemic activity. The further review is necessary for the individual phytoconstituents and their activities reported in detail.

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