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Review Article

An Overview of Abutilon Indicum (L) Sweet

Jansi Rani S.*, Mohamed Halith S., Praveen R., Praveen Kumar R., Praveen Kumar S., Preethi A. B., Prema K.

Dhanalakshmi Srinivasan College of Pharmacy, Tamilnadu

Abutilon Indicum is an herbaceous plant belongs to family Malvaceae. It is a weed abundantly found in hotter part of India along road sides This plant has been widely used in ayurvedic, herbal and folk medicine for the treatment of many diseases like diabetes, leprosy, ulcer, jaundice. Plants of A.indicum possess many phytochemical with various bioactivities including antioxidant, anti-inflammatory and anticancer. The plant is widely used as hepato-protective, anti- inflammatory, analgesic, antioxidative, hypoglycemic, antifungal, wounds healing, lipid lowering and larvicidal properties. The gc-ms results in previous work was eight distinct chemicals were found in the investigation. The qualitative UV-Vis spectral profile of leaf aqueous extract was obtained at wavelengths ranging from 200 to 1100 nm .The profile showed two peaks at 321 and 270 nm, with absorption values of 1.975 and 1.487, respectively. In order to identify and separate the active components, further TLC was carried out based on the phytochemical screening. Analysis of fluorescence was examined for the fluorescence properties of AI.The quercetin flavonoid was found to be better separated using toluene, ethyl acetate, and formic acid in a ratio of 5:4:0.2. FTIR spectroscopy tests revealed the existence of numerous chemical compounds in the aqueous extract of A. indicum with distinct peaks values (Table: 3 and Fig. 9), which correspond to 3436.2, 2171.7, 1636.2, 1407.1, 1347.6,1254.5, 1130.4, 1047.1, and 904.3 cm-1 stretching frequency.

Keywords: Abutilon Indicum (L), diabetes, leprosy, ulcer, jaundice.

INTRODUCTION

Medicinal plants are of great importance to the health of individuals and communities. The medicinal value of the plants lies in some chemical substances that produce a definite physiological action on the human body. Higher plants are sources of bioactive compounds continue to play a dominant role in the maintenance of human health. Reports available on the green plants to represent a reservoir of effective chemotherapeutics, which are non-phytotoxic, more systemic and biodegradable. Plants are rich source of secondary metabolites with interesting biological activities. In general, these secondary metabolites are important source with a variety of structural arrangements and properties (1). The medicinal values depend on presence of phytoconstituents in plants. The phytoconstituents are also known as plant secondary metabolites which are available in less quantity in plants. The availability of these plant secondary metabolites are mainly depend on minerals uptakes by the plant Abutilon indicum (Linn.) Sweet plant is commonly known as Indian mallow/Atibala/Thuthi, originated in India. In hot temperature zone, the plant is mainly distributed but due to habitat lost, this plant became endangered especially in Karnataka, India (2). A. indicum is an herbaceous plant belongs to family Malvaceae. It is a weed abundantly found in hotter part of India along road sides This plant has been widely used in ayurvedic, herbal and folk medicine for the treatment of many diseases like diabetes, leprosy, ulcer, jaundice. Plants of A. indicum possess many phytochemicals with various bioactivities including antioxidant, anti-inflammatory and anticancer. The plant is widely used as hepato-protective, anti-inflammatory, analgesic, antioxidative, hypoglycemic, antifungal, wounds healing, lipid

lowering and larvicidal properties. The leaves are effective in ulcer, for the treatment of diabetes, diuretic infection and gingivitis (3). Many components of the A. indicum plant, including leaves, stems, roots, flowers, bark, and seeds are used for diversified activities such as anti-inflammatory, antioxidant, diuretic, laxative, anti-ulcer, immunomodulatory, hypoglycemic, antimicrobial, infertility and analgesic treatments in traditional medical systems. Due to cytotoxic properties, plant secondary metabolites have been employed in the treatment of tumors. The chloroform leaf extract of A. indicum contains several cytotoxic substances, including methyl caffeate, syringic acid, stigmasterol, quercetin, and cholesterol (4). This plant offers numerous physical condition benefits, together with anti-inflammatory and anti-proliferative effects, arthritis pain relief, pain management, calming properties, liver protection, diabetes and cancer prevention, diarrhea and seizure control, lice eradication, wound healing, asthma alleviation, diuretic effects, and estrogen level reduction (5).

Plant Description

Abutilon indicum (Linn.) Sweet plant is commonly known as Indian mallow/Atibala/Thuthi, originated in India. In hot temperature zone, the plant is mainly distributed but due to habitat lost, this plant became endangered especially in Karnataka, India (2). It is a perennial shrub, softly tomentous and upto 3m in height, the flowers are yellow in colour, peduncle jointed above the middle. The petioles are 3.8-7.5 cm long (6). A. indicum is an herbaceous plant belongs to family Malvaceae. It is a weed abundantly found in hotter part of India along road sides (3).

Botanical Description

Figure: 1 Abutilon indicum plant

The leaves are 1.9–2.5 cm long, oval, pointy, and serrated; they are rarely divided into three halves. The stems are split from the centre upward, and the flowers are yellow.3.8–7.5 cm is the length of the petiole. Nine millimeter is the stipule length. Usually between 2.5- and 5-mm length, the stalks are connected at the top and isolated at the axilla. The corolla is 2.5 cm in diameter, yellow, and opens in the evening. The sepals are 12.8 mm long, lobed in the centre, and the lobes are elliptical and tapering. The fruit is a capsule with a noticeable, horizontally extended beak and is heavily hairy. The stems are pubescent, robust, branching, and one to two meters high. The kidney-shaped, bumpy or somewhat star-shaped, hairy, black or dark brown seeds range in size from 3 to 5mm (7).

Leaf

The leaves are simple, petiolate, alternating, and cordate, with an acuminate apex, a fine serrated margin, and a symmetric base. They are green in colour, with the upper surface being darker than the lower, and they have a coriaceous texture, a hairy surface, a mucilaginous taste, a faint odour, and palmately reticulate venation. On the lower surface, the midrib is more noticeable. The leaves are 8–10 cm wide and 11–13 cm long. The petiole is cylindrical,

green, and has a hairy surface. Its dimensions are 0.1 to 0.6 cm in diameter and 1.5 to 22 cm in length

Flowers

Flowers are solitary, yellow, 2to3 cm across axillary, petlas 5, triangular ovates,7-8 mm impricate, deltoid obovate, stamina tube hirsute with stellate hairs, pedicells4-7 cm articulate near apex.

Figure: 2 a) Abutilon indicum leaf

Figure 2 b) Abutilon indicum flower

Root

A tap root with several lateral rootlets, cylindrical in shape, yellowish brown in colour, odourless, and mucilaginous in taste. Its dimensions are 0.5-1 cm in diameter and 6-11 cm in length. It has a fibrous fracture and a thick, woody surface that wrinkles longitudinally.

Figure:3 Root of Abutilon indicum

Stem

The stem is green, cylindrical, upright, and has monopodial branching with internodes that range in length from 0.5 to 7 cm. The stem and lateral branches are covered in many hairs. The stem is between 0.5 and 1 m long and 0.2 and 1 cm in diameter. It has a mucilaginous taste and faint odour with a fibrous fracture when dry (8).

Figure: 4 Stem of Abutilon indicum

Phytochemical Constituents of Abutilon Indicum (9-10)

Alkaloids

Alkaloids are present in leaves, stem, and root.

Uses

Demulcent, given as decoction for bronchitis, bilious diarrhea, and diuretic

Tannins

Tannins are present in leaves, stem, and root.

Uses

Gonorrhea, bladder inflammation, urethritis, anti-diabetic and nervine tonic.

Flavonoids

Flavonoids are present in leaf, stem and root

Uses

Hepatoprotective, hypoglycemic, analgesic

Proteins

Proteins are present in leaf, stem, and root.

Uses

Anti-mycotic, anti-diarrheal, and anti-convulsant.

Carbohydrates

Carbohydrates are present in leaf, stem, and root.

Uses

Larvicidal activity, wound healing and diuretic activity.

Sterols

Sterols are present in leaf, stem and root.

Uses

Anti-asthmatic, anti-oxidant

Glycosides

Glycosides are present in leaf, stem, and root.

Uses

Anti-oxidant and anti-bacterial activity.

Taxonamical Classification (11)

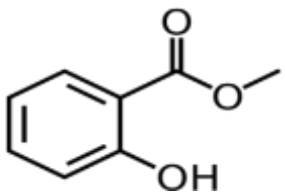
Kingdom	-	Plantae
Subkingdom	-	Tracheobionta
Division	-	Magnoliophyta
Class	-	Magnoliopsida
Subclass	-	Dilleniidae
Order	-	Malvales
Family	-	Malvaceae
Genus	-	Abutilon
Species	-	Indicum

Vernacular names of abutilon indicum: (6)

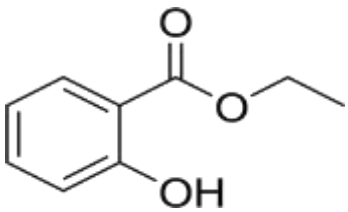
Hindi	-	Kanghi, Kakahi
English	-	Country mallow, Indian mallow
Bengali	-	Petari
Malayalam	-	Dabi, Uram
Guajarati	-	Khapat, Kansi, Dabli
Marathi	-	Mudra, Petari
Tamil	-	Tutti, Paniara, Hutti
Telugu	-	Tutturubenda

Chemical Structure Of Some Major Phytochemicals Of Abutilon Indicum

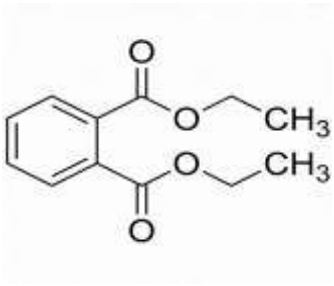
Methyl salicylate (4)



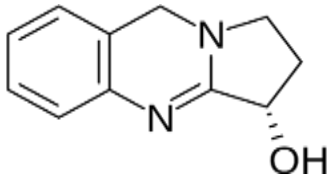
Ethyl salicylate (4)



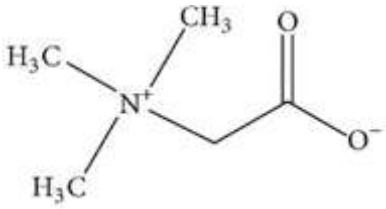
Diethyl phthalate (4)



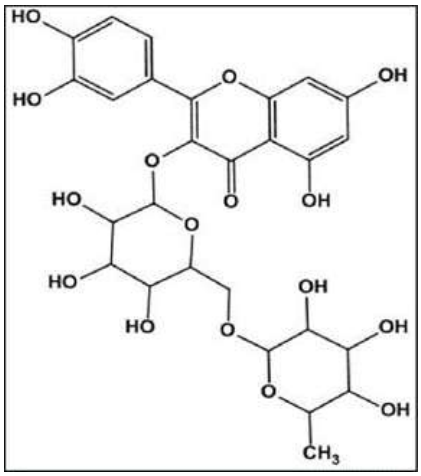
Vasicine (12)



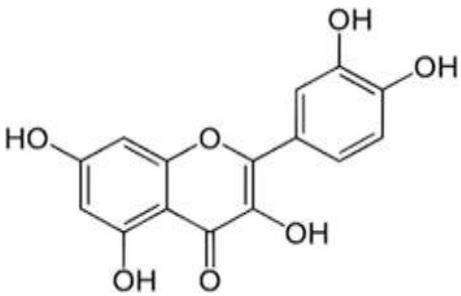
Betaine (12)



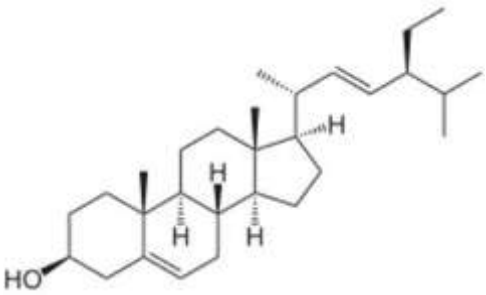
Rutin (12)



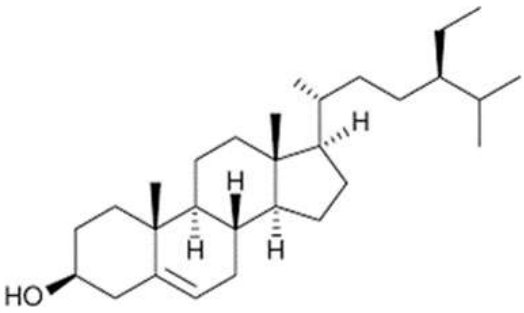
Quercetin (12)



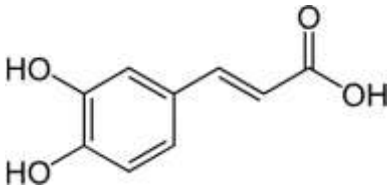
Stigmasterol (12)



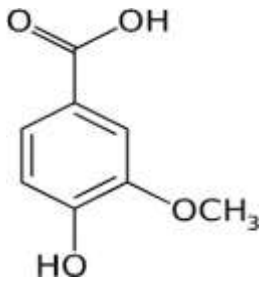
β – Sitosterol (12)



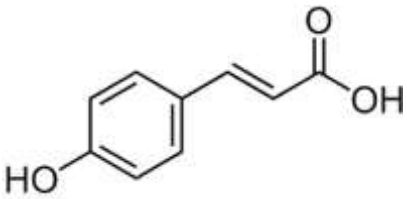
Caffeic acid (12)



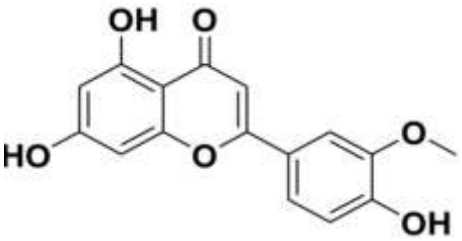
Vanillic acid (10)



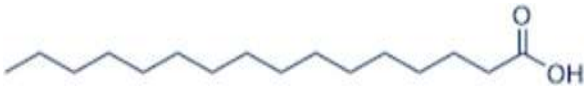
P-coumaric acid (10)



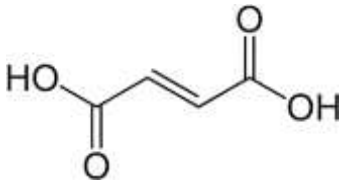
Chrysoreiol (10)



Palmitic (10)



Fumaric (10)



Pharmacological Activity of Abutilon Indicum

Antimicrobial activity

Abutilon indicum's antibacterial properties of well known. A wide range of pathogens, including Staphylococcus aureus, Escherichia coli, Candida albicans, and pseudomonas aeruginosa, are susceptible to the antibacterial and antifungal effects of its extracts. Alkaloids, flavonoids, and saponins are thought to be the cause of this activity since they harm bacteria' cell walls and membranes.

Anti-inflammatory activity

Abutilon indicum has been shown to have powerful activities, which are attributable to its bioactive constituents, including flavonoids and alkaloids. Studies have indicated that the plant can decrease the activity of cyclooxygenase enzymes [COX and COX-2], which are important mediators of inflammation. This action has been proven in models of acute and chronic inflammation, therefore it is a promising natural anti-inflammatory agent.

Anti-oxidant Activity

Activity of antioxidants, abutilon indicum's high concentration of phenolic components, such as flavonoids and tannins, is the main cause of its antioxidant qualities. As free radical scavengers, these

substances aid in shielding cells from oxidative stress, a factor that contributes to ageing and a number of chronic illnesses, including cancer, cardiovascular disease, and neurological disorders. The plant's potent antioxidant ability has been verified by antioxidant tests such DPPH, ABTS, and FRAP.

Anti-diabetic activity

Abutilon indicum has shown promise as a natural remedy for diabetes. Research has demonstrated that its extracts can lower blood glucose levels and improve insulin sensitivity in diabetic rats. This is attributed to the plant's flavonoids and glycosides, which promote insulin resistance. Additionally, the plant has been shown to alleviate diabetes-related complications, such as nephropathy and retinopathy, by reducing oxidative stress and inflammation.

Wound healing activity

The plant has showed the ability to promote wound healing. In animal models of skin wounds, its extracts have been proven to speed up tissue regeneration, reduce inflammation, and boost collagen production. This makes it a candidate to produce topical formulations for wound healing (12).

Anthelmintic activity

Abutilon indicum has traditionally been used as a deworming agent, and new research has shown that it is effective against parasitic worms. It has demonstrated efficacy against trematodes and nematodes, and its components may paralyze or interfere with the metabolism of this, it is a potentially effective treatment for intestinal helminth infections, especially in areas where parasitic disorders are common.

Hepatoprotective activity

Abutilon indicum has been shown to protect the liver from damaged caused by poisonous chemical such as carbon tetrachloride. The plants ability to lower AST and ALT levels and restore normal liver function suggests its promise as a protective agent for hepatocytes. These data indicate that abutilon indicum may be beneficial for managing liver disorders.

Neuroprotective activity

Abutilon indicum may have neuroprotective properties, according to research, especially when it comes to neurodegenerative conditions like Parkinson's and Alzheimer's. The plant's anti-inflammatory and antioxidative damage to brain structures. Research has demonstrated that it can enhance memory and learning in animal models, to indicating that it may be used to treat neurodegenerative diseases and cognitive impairment.

Anti-cancer activity

According to recent research, extracts from Abutilon indicum contain anticancer qualities and have cytotoxic effects on a number of cancer cell lines, including leukaemia, colon cancer, and breast cancer. It is thought that the plant's bioactive substances, like flavonoids and alkaloids, cause apoptosis, or programmed cell death, and prevent cancer cell from proliferating by down regulating cell cycle-related proteins (12).

Larvicidal activity

The larvicidal activity of crude hexane, ethyl acetate, petroleum ether, acetone, and ethanolic extracts of A. indicum was determined. Petroleum ether extract had the highest larval mortality rate, and β-sitosterol was identified as a potential novel mosquito larvicidal chemical with an LC50 value of 26.67 ppm against C. quinquefasciatus.

Hypoglycemic Activity

A. indicum leaf extracts' hypoglycemic effects on rats were investigated. Blood glucose levels were significantly lowered by the alcoholic and aqueous extracts. Glycosides promote insulin release in pancreatic β-cells, while flavonoids are known to repair injured β-cells (10).

Anti-Estrogenic Activity

A. indicum methanolic extracts were investigated for their anti-estrogenic effects on uterotropic and uterine peroxidase activities in ovariectomised rats. In contrast to the group that did not receive oestradiol

treatment, which showed a little increase in peroxidase activity, this extract was found to significantly decrease both the uterotropic response and enzyme activity. A. indicum must be a very strong oestrogen antagonist with a very low level of estrogenicity based on these variations in peroxidase activity.

Anti-arthritic Activity

Anti-arthritic properties of the several A. indicum extracts were examined in in vitro experiments using male albino rats. There was notable anti-arthritic efficacy in the methanolic extract of A. indicum. A. indicum 400mg/kg treatment resulted in a substantial ($P<0.01$) decrease in paw volume on days seven and fourteen. In this context, methotrexate, the reference standard, also displayed that 100 and 200 mg/kg of A. indicum had no effect on paw volume.

Anti-convulsant Activity

The anticonvulsant efficacy of Abutilon indicum leaf extracts was examined utilizing pentylene tetrazole (PTZ) and maximum electro shock (MES) produced convulsions in wistar rats.

Diuretic Activity

The diuretic activity of A.indicum Linn. Seed extract was studied in rats. The diuretic and natriuretic actions were carried out by administering normal saline with the treatment modules. Urine volume (in ml), as well as Na+ and K+ concentration, were measured (13).

Analgesic Activity

The analgesic properties of different extracts of the root of A. indicum Linn were investigated. The activity could be related to a central mechanism or to peripheral analgesic processes. Thus, they validated the traditional use of A. indicum (6).

Analytical Methods for Standardization Of Abutilon Indicum

UV- Visible spectroscopy

The qualitative UV-Vis spectral profile of leaf aqueous extract was obtained at wavelengths ranging from 200 to 1100 nm. The profile showed two peaks at 321 and 270 nm, with absorption values of 1.975 and 1.487, respectively (Table 1 and Fig. 5). The UV-Vis spectrum has absorption bands at 321 and 270 nm, which are characteristic of flavonoids and their derivatives. Flavonoids spectra typically have two absorption peaks at 230-290 nm (band I) and 300-350 nm (band II). The precise position and relative intensities of these maxima provide important information about the nature of the flavonoids. Our findings are consistent with earlier investigations.

Table: 1 UV-Vis peak values of leaf aqueous extract of Abutilon indicum

S.NO	Wave length (nm)	Absorbance
1.	27	1.975
2.	321	1.487

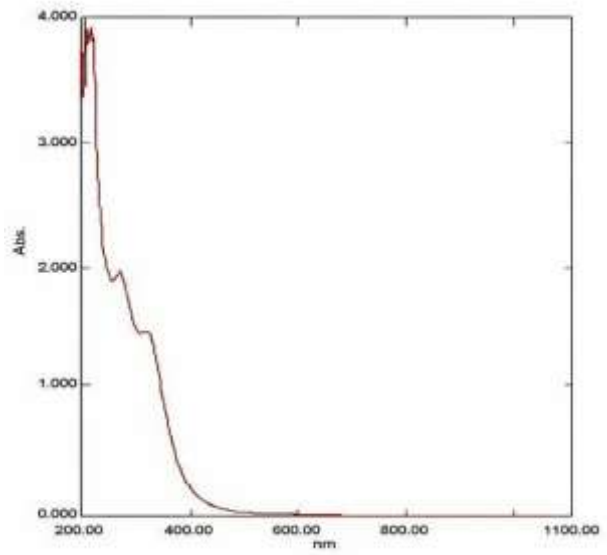


Figure: 5 UV-Vis spectra of leaf aqueous extract of A. indicum

UV-Vis and FTIR spectroscopy have been proven to be a reliable and sensitive approach for detecting biomolecular composition. The FTIR and UV-Vis spectra of the leaf extract revealed the presence of phenols and flavonoids. Because FTIR and UV-Vis profiles revealed the existence of phenolic and flavonoid chemicals in the leaf aqueous extract of A. Indicum, the quantitative analysis aims to determine the amount of these natural antioxidants in the leaf extract (3).

Thin Layer Chromatography

The current study was chosen to isolate polyphenolic compounds with substantial antioxidant activity, such as gallic acid and quercetin, based on the presence of secondary metabolites in plants and their impact on antioxidant activity. After using a variety of solvent systems to clearly separate the contents, a combination of toluene, ethyl acetate, and formic acid was chosen for the detection and isolation of the aforementioned chemicals. In order to identify and separate the active components, further TLC was carried out based on the phytochemical screening. The quercetin flavonoid was found to be better separated using toluene, ethyl acetate, and formic acid in a ratio of 5:4:0.2, while gallic acid was better separated using the same solvent in a ratio of 7:5:1. Gallic acid and quercetin were both clearly visible in the methanol extract (under UV 366 nm), but quercetin was less visible in the aqueous extract and gallic acid was not detectable (2).

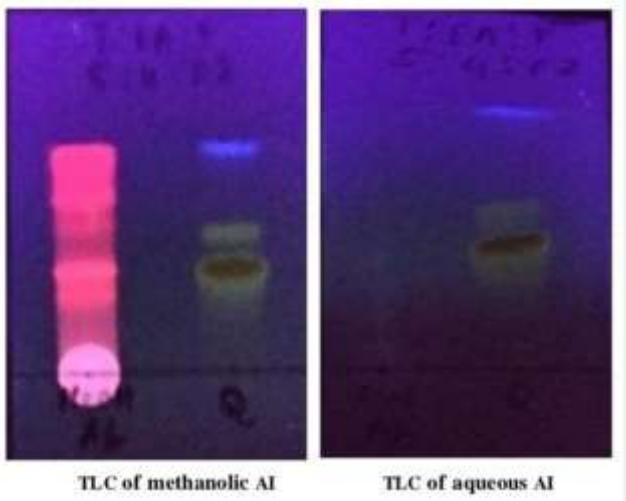


Figure: 6 TLC of aqueous and methanolic AI extract compared with standard quercetin

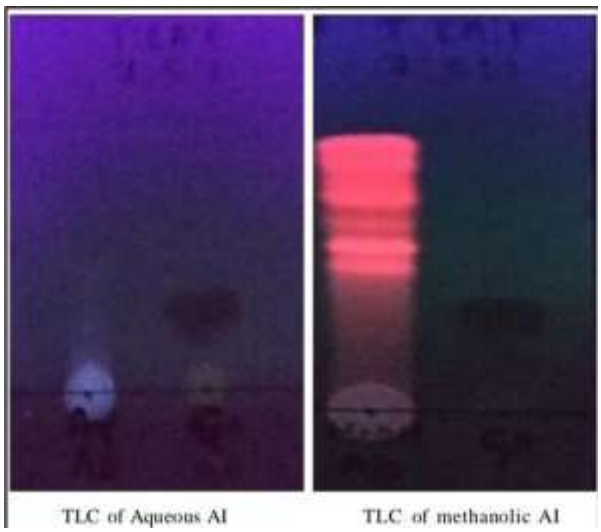


Figure: 7 TLC of aqueous and methanolic AI extract compared with standard gallic acid

GC-MS Analysis

The number of chemicals from the GC fractions of the methanol extract of Abutilon indicum (Linn.) Sweet is identified based on the GC-MS analysis results. Eight distinct chemicals were found in this investigation, including oleic acid (C18H34O2), 10-undecen-1 al, 2-methyl (C12H22O), (Z)6, (Z)9-Pentadecadien-1-Ol (C15H28O), Phytol (C20H40O), 17-Octadecyonic Acid (C18H32O2), n-Hexadecanoic acid (C16H32O2), Oxirane, tetradecyl (C16H32O), and 3,7,11,15-Tetramethyl- 2-hexadecane-1-ol (C20H40O) were found as major compounds (Fig No.8) represents the total GC-MS spectra of the methanolic extract of whole plant (9).

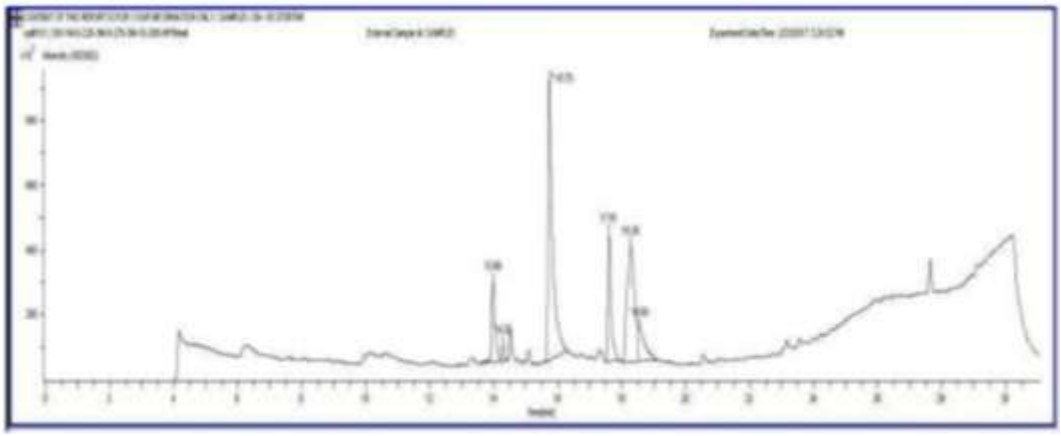


Figure: 8 GC-MS anlysis of methanolic extract of Abutilon indicum (linn.) Sweet whole plant

Table: 2 Phyto components identified in methanolic extract of Abutilon indicum (GC-MS)

	Compound name	RT	Molecular formula	Molecular weight	Medicinal activity
1.	Oleic acid	23.25	$C_{18}H_{34}O_2$	282	Anti-inflammatory, Flavor, Insectifuge, Antiandrogenic, Cancer preventive, Dermatigenic, Hypochlesterolemic, 5-Alpha reductase inhibitor, Anemiagenic
2.	10- Undecen-1 al, 2-methyl	18.58	$C_{12}H_{22}O$	182	Anti- microbial, Anti- inflammatory activity
3.	(Z) 6, (Z) 9-Pentadecadien-1-Ol	18.3	$C_{15}H_{28}O$	224	Anti-oxidant, Anti-microbial activity.

4.	Phytol	17.61	$C_{20}H_{40}O$	296	Hypocholesterolemic, Anti-microbial, Anti-cancer, Cancer preventive, Diuretic, Anti-Inflammatory
5.	17-Octadecyonic Acid	17.29	$C_{18}H_{32}O_2$	280	Anti-hypertensive
6.	n- Hexadecanoic acid	15.74	$C_{16}H_{32}O_2$	256	Lubricant, Anti-androgenic flavor, Hypocholesterolemic flavor, Hemolytic, Anti-oxidant, Pesticide, 5-alpha reductase inhibitor.
7.	Oxirane tetradecyl	14.54	$C_{16}H_{32}O$	240	No activity reported.
8.	3, 7, 11, 15-Tetramethyl-2-hexadecane-1-ol	13.97	$C_{20}H_{40}O$	296	Anti-microbial and Anti-inflammatory activity.

FTIR

The FTIR spectrum was utilized to identify the functional group of the active components based on the peak value in the infrared radiation band. FTIR spectroscopy tests revealed the existence of numerous chemical compounds in the aqueous extract of A. indicum with distinct peaks values (Table: 3 and Fig. 9), which correspond to 3436.2, 2171.7, 1636.2, 1407.1, 1347.6, 1254.5, 1130.4, 1047.1, and 904.3 cm-1 stretching frequency. The amino acid stretching frequency accounts for the IR stretching frequency at 2171.7 cm -1. A prominent peak at 1636.2 cm-1 corresponds to a carbonyl C=O group, which is most commonly linked with amides. The -COOH and CH2 groups produced bands at 1407.1 and 1347.6 cm-1, respectively. The absence of any peak at 2260 cm-1 demonstrates the absence of a cyanide group in the extract, demonstrating the plants' harmless nature. A peak at 2171 and 1047 cm-1 shows the presence of sulfur-containing amino acids in A. indicum proteins, which have been shown to behave as antioxidants in plants under oxidative stress conditions [31]. The strong bands observed at 1254.4 and 1130 stretching indicate the presence of esters and secondary alcohols. A significant peak at 3436.2 cm-1 stretching in FTIR corresponds to the OH group, confirming the existence of phenolic chemicals in the leaf extract of A. indicum. Thus, the FTIR spectrum verified that the leaf aqueous extract of A. indicum contained phenols, amino acids, amides, carboxylic acids, alkanes, aliphatic esters, secondary alcohols, sulphur compounds, and mono substituted alkenes (3).

Table: 3 FTIR peak values of leaf aqueous extract of Abutilon indicum

Peak values	Functional groups
3436.2	Phenols
2171.7	Amino acids
1636.2	Amides
1407.1	Carboxylic acids
1347.6	Alkanes
1254.5	Aliphatic esters
1130.4	Secondary alcohols
1047.1	Sulfur compounds
904.3	Mono substituted alkenes

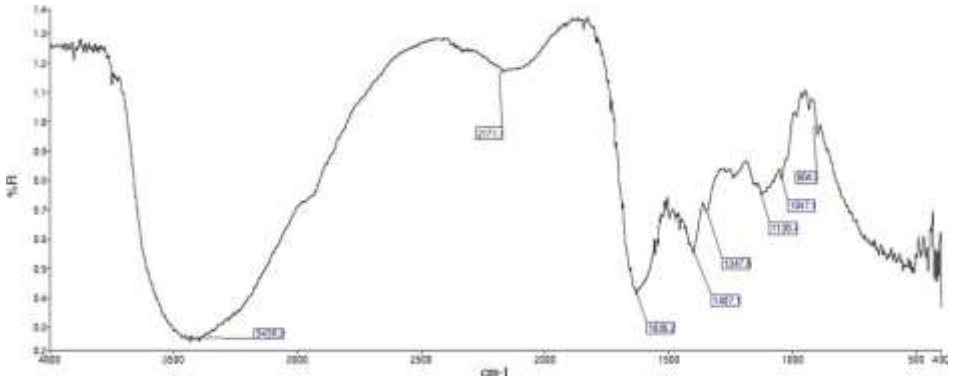


Figure: 9 FTIR spectra of leaf aqueous extract of Abutilon indicum

Fluorescence analysis

Analysis of fluorescence to examine the fluorescence properties, the fruit powder and different extracts were exposed to UV radiation with both long and short wavelengths as well as regular visible light. They released radiations of different colours.The distinctive and repeatable colour shift for the fruit powder and individual extract showed the phytoconstituents' solvent characteristics (14).

Table: 4 Flurescence analysis of Abutilon indicum

As powder	Light green	Green	Dark green
1N hydrochloric acid	Greenish White	Greenish White	Greenish White
5% sodium hydroxide	Cream	Green	Dark green
50% sulfuric acid	Brown	Green	Dark green
5% acetic acid	Cream	Cream	Cream
50% nitric acid	Cream	Green	Dark green
Picric acid	Cream yellow	Yellow	Bright yellow
Dilute iodine solution	Light brown	Green	Dark green
5% ferric chloride	Light brown	Light brown	Light brown
Water	Cream	Cream	Cream
Alcohol	Ash	Ash	Ash

CONCLUSION

Based on various studies the conclusion on Abutilon indicum emphasize its significant potential and and multi-talented medicinal plant. The gc-ms results in previous work was eight distinct chemicals were found in the investigation. The qualitative UV-Vis spectral profile of leaf aqueous extract was obtained at wavelengths ranging from 200 to 1100 nm. The profile showed two peaks at 321 and 270 nm, with absorption values of 1.975 and 1.487, respectively. In order to identify and separate the active components, further TLC was carried out based on the phytochemical screening. The quercetin flavonoid was found to be better separated using toluene, ethyl acetate, and formic acid in a ratio of 5:4:0.2. FTIR spectroscopy tests revealed the existence of numerous chemical compounds in the aqueous extract of A. indicum with distinct peaks values which correspond to 3436.2, 2171.7, 1636.2, 1407.1, 1347.6,1254.5, 1130.4, 1047.1, and 904.3 cm-1 stretching frequency. Analysis of fluorescence was examined for the fluorescence properties of AI.

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