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Babu Giriya Gowda
Department of Chemistry, School of Sciences, Maharani Science College for Women, Maharani Cluster University, Bengaluru, Karnataka, India

Dr. Vishwanatha T
Department of Microbiology, School of Sciences, Maharani Science College for Women, Maharani Cluster University, Bengaluru, Karnataka, India

Pavani Thimmegowda
Department of Chemistry, School of Sciences, Maharani Science College for Women, Maharani Cluster University, Bengaluru, Karnataka, India

Bhavya Rangaswamy
Department of Chemistry, School of Sciences, Maharani Science College for Women, Maharani Cluster University, Bengaluru, Karnataka, India

Sharangouda J Patil
Department of Zoology, NMKRV College Autonomous, Bengaluru, Karnataka, India

Corresponding Author:
Dr. Vishwanatha T
Department of Microbiology, School of Sciences, Maharani Science College for Women, Maharani Cluster University, Bengaluru, Karnataka, India

The ethnopharmacological promise of *Costus pictus*: A scientific appraisal of its phytochemicals and bioactivities

Babu Giriya Gowda, Vishwanatha T, Pavani Thimmegowda, Bhavya Rangaswamy and Sharangouda J Patil

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Abstract
Costus pictus, an important traditional medicinal plant is exploited for treating several diseases. The present study intends to reveal the presence of phytochemicals and test some biological activities of *Costus pictus* leaf extracts. The methodology includes identification and collection of *Costus pictus* leaves, preparation of leaf powder, extracted by Soxhlet extraction method, preliminary phytochemical screening and determination of antidiabatic and antimicrobial activities on ethanol extract of leaves. Results revealed the presence of more active metabolites in the ethanol plant extract of *Costus pictus* leaves which may be the reason for the promising anti-diabatic, antibacterial and antifungal potential against the microbial strains. Its constituents are of utmost interest to pharmaceutical industries owing to their many actions and biological activities.

Keywords: *Costus pictus*, phytochemical screening, biological activity

Introduction
Costus pictus, commonly known as the “insulin plant” or “spiral ginger,” is traditionally used as a folk remedy for managing diabetes mellitus. It belongs to the Costaceae family, which is taxonomically distinguished from the Zingiberaceae family by its spiral leaf arrangement and rhizomes that lack aromatic essential oils. Native to Mexico, the plant has gained attention for its antidiabetic properties, and its preparations are widely used in traditional medicine for regulating blood glucose levels [1-4].

Herbal drugs are often considered safer alternatives to synthetic agents, as they are generally associated with fewer side effects [5]. Ethnobotanical surveys suggest that nearly 800 plant species exhibit potential antidiabetic activity [6]. Since many modern drugs are derived either directly or indirectly from plants, medicinal flora continues to serve as a vital source of new therapeutic agents [7, 8].

Apart from its antidiabetic relevance, different parts of *C. pictus* are used in ethnomedicine for various ailments. The stem, for example, is consumed as food after boiling or peeling, while stem decoctions are traditionally used in the treatment of fever and dysentery. Fresh stem juice is also employed in the management of ear and eye infections. The genus *Costus* comprises more than 100 species distributed across tropical regions worldwide. Morphologically, *C. pictus* is a perennial, spreading herb that grows up to two feet in height, with stems that may bend and lie on the ground. Its leaves are evergreen, simple, alternate, and 4-8 inches long with parallel venation. The broad, smooth, dark green leaves have light purple undersides and are arranged spirally around the stem, forming attractive clumps arising from underground rootstocks.

Given its traditional use and reported biological activities, this study was undertaken to extract phytoconstituents from fresh leaves of *C. pictus* and to evaluate their potential biological effects. Preliminary phytochemical screening was conducted to assess the metabolite profile. Further characterization of the ethanol extract was performed using Gas Chromatography-Mass Spectrometry (GC-MS), Fluorescence Spectroscopy, and Fourier Transform Infrared Spectroscopy (FTIR). The extract was also examined *in vitro* to investigate its therapeutic POTENTIAL.

Materials and Methods

Preparation of Crude Extract

Fresh, healthy leaves of *Costus pictus* were collected from the Maharani Cluster University campus, Bengaluru, India, and authenticated by the Department of Botany, Maharani Science College for Women. The leaves were washed thoroughly with distilled water, air-dried at room temperature, and then powdered using a mortar and pestle. About 30 g of dried powder was packed in filter paper and extracted in a Soxhlet apparatus with 200 mL of 90% ethanol maintained at 78 °C. The extract was filtered through Whatman No. 41 paper, concentrated, and dried at a low temperature. Purification of the extract was carried out using Thin Layer Chromatography (TLC). The purified material was then used for subsequent analyses.

All chemicals and solvents used were of analytical grade (S. D. Fine). Fluorescence spectra were recorded on a Hitachi F-4500 spectrofluorimeter (Japan) equipped with a xenon lamp and a quartz cell (1 cm path length). The FTIR spectra were obtained using a Thermo Scientific Nicolet Summit X spectrometer with OMNIC Paradigm software.

Qualitative phytochemical assay

Preliminary phytochemical screening of the ethanol extract was performed to identify major classes of secondary metabolites. Standard procedures described by Sharangouda and Patil (2007), Harborne (1973), and Farnsworth (1966) were followed to test for steroids, triterpenoids, alkaloids, tannins, flavonoids, glycosides, carbohydrates, proteins, and amino acids [9-11].

Thin Layer Chromatography (TLC)

TLC was used to further purify the extracts. Activated plates were marked with a baseline 1.5 cm from the bottom, and aliquots of the extract were spotted repeatedly at the same position until a concentrated spot formed. The solvent system used for development consisted of toluene, ethyl acetate, acetic acid, and methanol in the ratio 6:1.8:0.25. Plates were placed in a pre-saturated chamber, and the solvent was allowed to migrate until it reached 1.5 cm below the top edge [12].

Gas Chromatography-Mass Spectrometry (GC-MS)

GC-MS analysis was performed on a Clarus 680 GC equipped with an Elite-5MS column (30 m × 0.25 mm ID × 250 µm film thickness). Helium was used as the carrier gas at a constant flow rate of 2 mL/min. The injector was maintained at 220 °C, and 1 µL of extract was injected in split mode. The oven temperature program was as follows: initial 50 °C (2 min hold), ramped to 150 °C at 15 °C/min (2 min hold), and then increased to 250 °C at 30 °C/min with an 8 min hold. The mass spectrometer operated with an inlet line temperature of 250 °C, ion source at 230 °C, electron impact ionization at 70 eV, and a scan range of 40-600 Da. Spectral data were compared with the NIST 2014 library for compound identification [13, 14].

Fluorescence Spectroscopy

For fluorescence studies, the ethanol extract was dissolved in methanol, filtered through a 0.22 µm membrane, and adjusted to appropriate concentration to avoid inner filter effects. Spectra were recorded using a spectrofluorometer with excitation wavelengths between 250-400 nm, and emission was monitored in the 300-700 nm range. Both excitation and emission slit widths were set at 5 nm, and the scan speed was 120 nm/min. Measurements were performed at room temperature using quartz cuvettes (1 cm path length). Standard fluorophores such as quinine sulfate were used to validate the instrument response [15].

Fourier Transform Infrared (FTIR) Spectroscopy

Functional groups present in the extract were analyzed using FTIR. The dried plant material was mixed with spectroscopic-grade potassium bromide (KBr) in a 1:100 ratio and pressed into pellets. Spectra were recorded in the mid-infrared region (4000-400 cm^{-1}) at a resolution of 4 cm^{-1}, averaging 32 scans per sample to improve signal quality [16].

Antidiabetic Assay (α-Amylase Inhibition)

The α-amylase inhibitory activity was assessed using the DNS (dinitrosalicylic acid) method. A reaction mixture containing 500 µL of extract (0.01 g), 500 µL of sodium phosphate buffer (0.02 M, pH 6.9 with 0.006 M NaCl), and α-amylase enzyme solution (0.5 mg/mL) was incubated at 25 °C for 10 min. Subsequently, 500 µL of 1% starch solution prepared in the same buffer was added, and incubation continued for another 10 min. The reaction was terminated with 1 mL of DNS reagent, followed by heating in a boiling water bath for 5 min. After cooling, the mixture was diluted with 10 mL distilled water, and absorbance was measured at 540 nm [17, 18].

Antimicrobial Assay

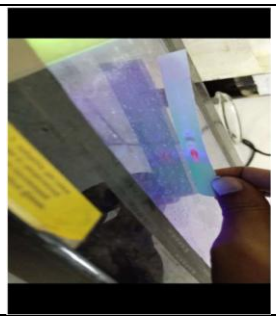
Antimicrobial activity of the extract was evaluated using the agar well diffusion method. Test organisms included *Staphylococcus aureus* (Gram-positive), *Escherichia coli* (Gram-negative), and *Aspergillus niger* (fungal). Cultures were standardized to 0.5 McFarland turbidity (≈ 1.5×10^8 CFU/mL). Mueller-Hinton agar plates were inoculated with bacterial or fungal suspensions, and wells of 6 mm diameter were made. Each well was filled with 100 µL of the extract solution. Plates were incubated at 37 °C for 24 h (bacteria) and 28 °C for 48 h (fungi). Ciprofloxacin and amphotericin B served as positive controls, while solvent alone acted as a negative control. Zones of inhibition were measured in millimeters, and all assays were performed in triplicate. Results were reported as Mean ± SD [19, 20].

Results and discussion

Thin Layer Chromatographic Method

The ethanol extract was subjected to thin layer chromatography (TLC) for separation of its constituents. A solvent system comprising toluene, ethyl acetate, acetic acid, and methanol in the ratio 6:1.8:0.25 (v/v) was employed as the mobile phase. After development, distinct bands appeared on the TLC plates, confirming the presence of multiple phytochemical components. The solvent front migrated evenly, producing clear and well-resolved spots upon visualization. The retention factor (Rf) for each band was determined as the ratio of the distance traveled by the compound to that of the solvent front. The range of Rf values obtained is summarized in Table 01.

Table 1: R_f values of different spots of leaf extract of *Costus pictus*

Spots	Distance travelled by solvent (cm)	Distance Travelled by solute (cm)	Retention factor (R_f)	
Spot 1 (Baby pink)	6.6	2.85	2.85/6.6 = 0.43	
Spot 2 (green)	6.6	4	4/6.6 = 0.606	
Spot 3 (Dark pink/Red)	6.6	5.3	5.3/6.6 = 0.803	

Preliminary Phytochemical Screening

Phytochemical profiling of the ethanol extract of *Costus pictus* leaves revealed the presence of several bioactive constituents, including flavonoids, glycosides, phenols, tannins, saponins, coumarins, terpenoids, and reducing sugars. The successful detection of these compounds suggests that the extraction and drying processes preserved their chemical stability. Ethanol was chosen as the extraction medium due to its favorable properties—low toxicity, minimal interference with active constituents, easy removal at low temperatures, and ability to act as a preservative.

The qualitative screening confirmed that the extract contains a diverse range of secondary metabolites such as alkaloids, flavonoids, phenols, lignins, furanoids, quinones, coumarins, terpenoids, carbohydrates, and reducing sugars. This chemical diversity reflects the complex nature of the plant extract and provides a rationale for its potential pharmacological applications. The summarized results of phytochemical detection are presented in Table 2.

Table 2: Qualitative phytochemical screening of leaf extract of *Costus pictus*.

Test	Procedure	Inference	Results
Triterpinoids	A few ml of the test solution was taken in a dry test tube and treated with a bit of tin foil, 0.5 ml of thionyl chloride and heated gently.	Appearance of pink colour	+ve
Alkaloids(dragen droff's test)	A small amount of test solution, mixed with acetic acid was treated with 2 drops of Dragon Droff Reagent	Orange yellow precipitation	+ve
Steroids	A small amount of the test solution was treated with a few drops of acetic acid anhydride, 2 drops of conc. H_2SO_4 and heated gently	Blue or green colour	-ve
Phenolic Test	A small amount of test solution was treated with alcoholic ferric chloride	Any colour	+ve
Reducing Sugars	1mL of dil. H_2SO_4 + 0.2 mL of extract boiled for 15 min + allowed to cool neutralize with 10% NaOH + 0.2 mL Fehling's solution A&B.	Yellow Colur	+ve
Phytosterol	Filtrate+few drops of Conc H_2SO_4	Red color (in lower layer)	-ve
Flavanoids	1mL extract + 2 mL of 2% NaOH solution+few drops of dil.HCL	An intense yellow colour become colourless on addition of dil. HCL	+ve
Carbohydrates	2 mL of Aq extract + few crystals of resorcinol +equal volume of Conc.HCL heated.	Rose Color	+ve
Lignins	Extract Solution+gallic acid	Olive green colour	+ve
Quinone	Plant extract + Conc HCL	Green color	+ve
Coumarin	Plant Extract + 10% NaOH + Chloroform	Yellow color ppt	+ve
Furanoids	A few ml of test solution was treated with a pinch of para-dimethyl aminobenzaldehyde and few drops of conc.HCl.	Pink Colour	+ve

Fluorescence Analysis

Fluorescence spectroscopy is a sensitive analytical method commonly used to characterize crude plant extracts [13]. Because many phytochemicals exhibit compound-specific fluorescence, the color and intensity of emission under UV light can provide useful insights into their chemical nature. Previous research has shown that crude drugs produce distinct fluorescence patterns at different excitation wavelengths, reflecting the diversity of their phytoconstituents [21, 22].

In the present study, powdered leaves of *Costus pictus* demonstrated clear fluorescence responses when excited at multiple wavelengths, particularly at 250 nm, 310 nm, 500 nm, and approximately 600 nm (Figure 1). These emission peaks are consistent with the presence of various classes of secondary metabolites. For example, saponins typically fluoresce in the 200-260 nm range, alkaloids between 300-360 nm, lignins around 280-360 nm, flavonoids near 490 nm, and anthocyanins within 360-530 nm. The fluorescence profile obtained in this work therefore supports the preliminary phytochemical findings, confirming the presence of multiple bioactive groups in the ethanol extract of *C. pictus*.

FT-IR Spectroscopy Study

Fourier Transform Infrared (FT-IR) spectroscopy was employed to identify characteristic absorption peaks and the corresponding functional groups present in the plant extract. The ethanolic leaf extract of *Costus pictus* was analyzed, and the functional groups were determined by interpreting the absorption bands in relation to their peak positions and intensities. The FT-IR spectrum of the extract is presented in Figure 2, while the major peak values along with their assigned functional groups are summarized in Table 3.

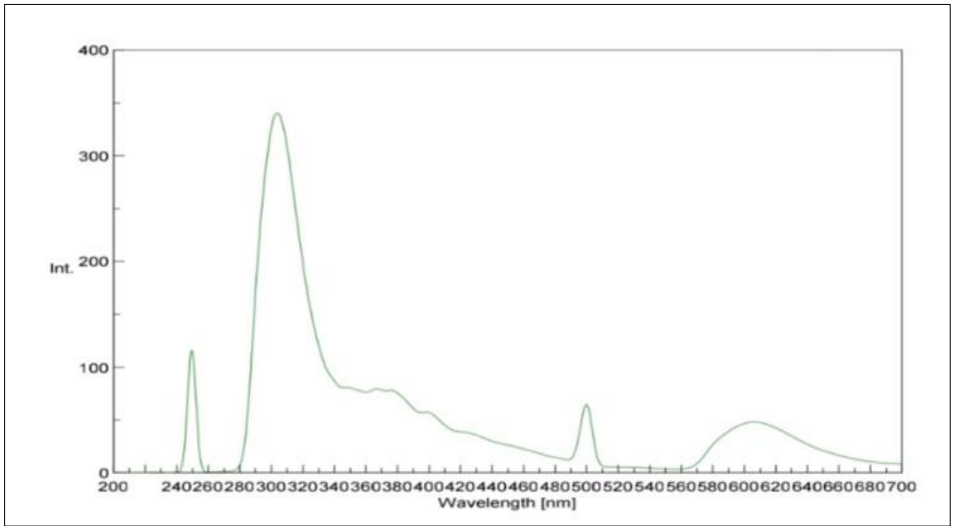


Fig 1: Fluorescence spectra of ethanolic extract of *Costus pictus* leaf

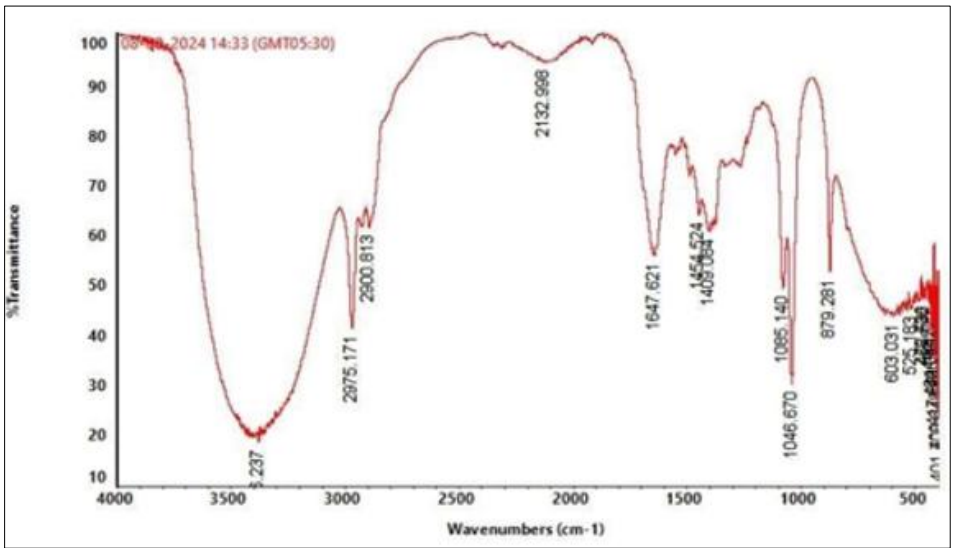


Fig 2: FTIR chromatogram of ethanolic extract of *Costus pictus* leaf.

FT-IR Spectroscopy Analysis

FT-IR spectroscopy is a reliable and sensitive tool for identifying molecular bonds and functional groups in plant extracts. In this technique, absorption bands are recorded within the infrared region, where each peak corresponds to the vibrational frequency of a specific chemical bond [12]. The spectra obtained often display overlapping signals, as individual bands represent the combined absorption of several functional groups present in the sample.

In the present study, FT-IR analysis of the ethanolic leaf extract of *Costus pictus* revealed multiple characteristic peaks. These peaks confirmed the presence of diverse functional groups, including alcohols, phenolics, primary alcohols, alkanes, alkynes, and ketones. Such compounds contribute to the complex phytochemical profile of the extract and highlight its potential pharmaceutical relevance. The observed functional group assignments and their corresponding absorption values are summarized in Table 3, and they are consistent with values previously reported in the literature [23, 24].

Table 3: FT-IR peak values and functional groups of ethanolic extract of leaf of *Costus pictus*

Wavelength cm^{-1}	Functional group
2900	C-H (Stretching)
3237	Carboxylic acid
1647	C = C, Carbonyl compounds (1700-1800), imines and oximes (1690)
1085	C-O (1000-1300) (alcohols, esters, ethers, carboxylic acid, anhydride)
1409, 785, 603, 625	Halogens (C-F-1400, C-Cl-785, C-Br-685, C-I-500)

GCMS analysis

GCMS analysis is used to determine whether the plant species contains any individual compound or group of compounds and also used to understanding the nature of active principles in medicinal plants. The heights of the peak indicate the relative concentrations of the components present in the extract. Different phytochemical compounds of the ethanolic extract of leaf of *Costus pictus* was examined by using GCMS. The chromatogram of the extract was revealed in Figure 3 and summarized in Table 4.

GCMS study of ethanolic leaf extract of *Costus pictus* revealed the presence of ten largest peaks in chloral and n-Hexadecanoic acid. The major chemical constituents include Pentanoic acid (28.8%), Phenol 3,5-bis (1,1, dimethyl ethyl) (20.3%), 2,4, di tertiary butylphenol (17.1%), Phenol,2,5-bis(1,1-dimethylethyl) (13.1%) and Phenol,2,6-(bis (1,1-dimethylethyl) (8.22%), Pentanedioic acid (Glutaric acid) (7.9%), Oxirane octyl (22.6%), 2-Tetradecanone (6.28%), Dibutyl phthalate (16.7%). GC-MS analysis of leaf extract shows 16 peaks at 29, 41, 57, 74, 83, 91, 107, 135, 147, 163, 175, 191, 206, 233, 245 and at 306.

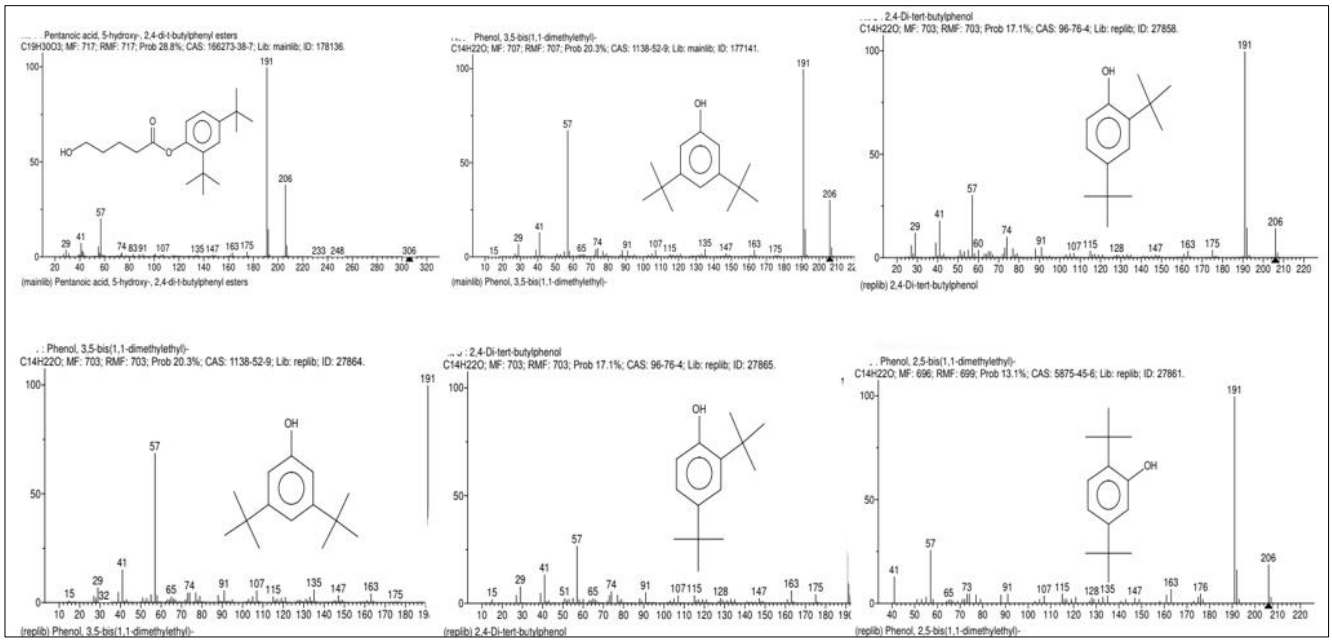
Table 4: Bioactive compounds present in ethanolic extract of *Costus pictus* leaf extract.

Name	% Prob	Nature	Molecular weight (g)	Molecular Formula	Biological Improtance
Pentanoic acid (valeric acid)	28.8	Straight chain,saturated fatty acid	306.21	$C_{19}H_{30}O_3$	Neuroprotection For treating insomnia,pain, Neurosis and dipression
Phenol 3,5-bis(1,1,dimethyl ethyl)	20.3	Class of phenols	206.16	$C_{14}H_{22}O$	Antioxidents Herbicides Major source of anticancerous
2,4,di tertiary butylphenol	17.1	Class of phenols	206.16	$C_{14}H_{22}O$	Anti oxidant Antifungul Toxic 2^0 metabolites Cancer cell sensitivity
Phenol,2,5-bis(1,1-dimethylethyl)	13.1	Class of phenols	206.16	$C_{14}H_{22}O$	Anti bacterial Antifungul Antioxidant Antifungul Anticancerous
Phenol,2,6-(bis (1,1-dimethylethyl)	8.22	Class of phenols	206.16	$C_{14}H_{22}O$	Majorly Antioxident
Pentanedioic acid(Glutaric acid)	7.90	Alpha,omega, dicarboxylic acid	320.19	$C_{14}H_{22}O$	Neurotoxicity Metabolic pathway Urine analysis

Name	% prob	Nature	Mw (g)	Mf	Biological Importance
Dibutyl phthalate	16.7	Phthalate ester (Has 2 fatty acid side chain)	278.15	$C_{16}H_{22}O_4$	Pesticizer As solvent for perfume and resin
1,2 benzenedicarboxylic acid,butyl 2-ethyhexylester	11.4	Dicarboxylic acids	334.21	$C_{20}H_{30}O_4$	Apoptosis inhibitor Androstane receptor agonist plasticizer
Phthalic acid butyl hex-3-yl ester	5.55	Has 2 fatty acid side chain	306.18	$C_{18}H_{26}O_4$	Allelopathic Antimicrobial insecticidal
Phthalic acid,6 ethyl-3-octyl butyl ester	5.33	Has 2 fatty acid side chain	362.24	$C_{22}H_{34}O_4$	Allelopathic Antimicrobial insecticidal
1,2 Benzenedicarboxylicacid,butyl cyclohexyl ester	4.50	Dicarboxylic acids	304.16	$C_{18}H_{24}O_4$	Apoptosis inhibitor Androstane receptor agonist plasticizer
Phthalic acid,butyl hept-3-yl ester	3.63	Has 2 fatty acid side chain	320.19	$C_{19}H_{28}O_4$	Allelopathic Antimicrobial insecticidal

Name	% prob	Nature	Mw (g)	Mf	Biological Importance
Oxirane octyl	22.6	Epoxides	156.15	$C_{10}H_{20}O$	Found in natural products like cryptophycin A and B which have Anti cancer property
2-Pentadecanone,6,10,14-trymethyl (hexahydrofarnesyl acetone)	6.28	sesquiterpene	268.27	$C_{18}H_{36}O$	Antibacterial Anti-inflammatory Anticancerous
2-Tetradecanone	6.28	Member of ketone	212.21	$C_{14}H_{28}O$	Antibacterial against staphilococcus aureus
Oxirane tetradecyl	5.79	Epoxides	240.24	$C_{16}H_{32}O$	Antibacterial and bioactive properties
Oxirane pentyl	5.34	Epoxides	114.10	$C_7H_{14}O$	Antiinflammaotory, Antineoplastic
Oxirane,(2-methylbutyl)	4.72	Epoxides	114.10	$C_7H_{14}O$	Antihypercholesterolemic, Antiperkinsonian
Carbonic acid	3.99	Weak,unstable diprotic acid(i.e,,forms dicarbonate and carbonate)	228.17	$C_{13}H_{24}O$	Important in the transport of carbon dioxide in the blood
Hexadecanal,2 methyl	3.99	Long chain fatty aldehyde	254.26	$C_{17}H_{34}O$	Human metabolism Pheramones Baby emission
2-Dodecanone	3.68	ketone	184.18	$C_{12}H_{24}O$	Can alter the transcriptional activity of gene
Name	% prob	Nature	Mw (g)	Mf	Biological Importance
Di-n decysulfones	27.9	Sulfones	346.29	$C_{20}H_{42}O_2S$	Anti-inflammatory, Antihelmintic Antimicrobial, Anticancer, Anti-HIV, Antimalarial
d-Mannitol,1-decylsulfonyl	1.96	sugar alcohol with sulfur	370.20	$C_{16}H_{34}O_7S$	Has antimicrobial and anticancer properties.
Heneicosane,3 methyl	1.88	Hydrocarbon	310.35	$C_{22}H_{46}$	Antimictrobial, Pheromones Mosquito bait, Coffee bean
Nonane3,7-dimethyl	1.66	Hydrocarbon(component of kerosene)	156.18	$C_{11}H_{24}$	It's a component of kerosene, which is used for heating, tractors, and jet fuel.
Eicosane,2-methyl	1.53	Hydrocarbon	296.34	$C_{21}H_{44}$	Neuroprotective, Anti-inflammaotory
Decane,2,9-dimethyl	1.47	Hydrocarbon	170.20	$C_{12}H_{26}$	biological metabolite that can be found in plants, bacteria, fungi,and volatile oils.

GC-MS mass spectra detected some bioactive compounds from ethanolic extract of *Costus pictus* leaves. Mass matching of the spectrums of prominent compounds present in the experimental sample was done with the spectrum of standard compounds of NIST library as shown in Figure 3.



Biological Activity of Ethanolic Extract of Leaves of *Costus pictus*

Antidiabetic Assay

The observed antidiabetic activity of *Costus pictus* leaf extract, demonstrating a 69.6% inhibition, indicates a substantial potential for modulating glucose metabolism through biochemical pathways relevant to diabetes management (Table 5). This high percentage suggests that the extract may effectively inhibit key carbohydrate-hydrolyzing enzymes such as α-amylase and α-glucosidase, thereby reducing postprandial glucose spikes. The presence of bioactive phytoconstituents—such as flavonoids, alkaloids, saponins, and terpenoids—likely contributes to this effect by enhancing insulin sensitivity, promoting glucose uptake, and exerting antioxidant protection against pancreatic β-cell damage. These findings align with the traditional use of *Costus pictus*, often referred to as the "insulin plant," and support its therapeutic relevance in complementary and integrative approaches to diabetes care. Further mechanistic studies and *in vivo* validations would strengthen its translational potential in phytomedicine.

Table 5: Antidiabetic assay of *Costus pictus* leaves

Extract	Anti-Diabetic Property in%
Costus pictus leaves	69.6%

Antimicrobial activity

The antibacterial activity of *Costus pictus leaf extract* were tested by well diffusion method against the pathogenic bacteria *Staphylococcus aureus* (Gram +ve) and *E. coli* (Gram-ve). The antibacterial property of extract reveals the diameter of the zone of inhibition 18mm (1mL), 10mm (0.75mL), 5mm (0.50mL), 2 mm (0.25mL) for *E.coli* (Figure a) and 20mm (1mL), 10mm (0.75mL), 5mm(0.50mL), 2 mm (0.25mL) for *Staphylococcus aureus* (Figure B) these results agreed with the results of already reported method (Sreedharan *et al*., 2020). The *Costus pictus leaves extract* has antibacterial activity against the pathogenic bacteria *S. aureus* and *E. Coli*.

Table 6: Antibacterial activity of *Costus pictus* leaves by well diffusion method

Test Organism (Antibacterial)	Zone of Inhibition in Test Sample			
	Sample : *Costus pictus leaf extract*			
	Concentration in mL			
	0.25	**0.50**	**0.75**	**1.0**
Staphylococcus aureus	3mm	7mm	14mm	20mm
Escherichia coli	2 mm	5mm	10mm	18mm

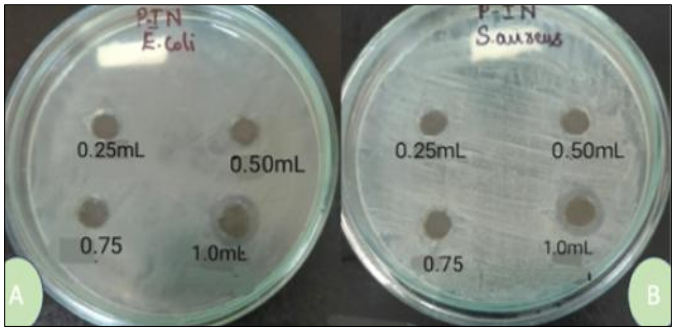


Fig (a): *E. Coli* **Fig (b):** *S.aureus*

Antifungul activity

The antifungul activity of extract was tested against aspergillus niger and it reveals the diameter of the zone of inhibition 8mm (1.0mL), 6mm (0.75mL), 4mm (0.50mL), 2 mm (0.25mL). These results agreed with the results of already reported method. [19] The *Costus pictus leaf extract* has antifungul activity against *Aspergillus niger*.

Table 7: Antifungal activity of *Costus pictus* leaves by well diffusion method

Test Organism	Zone of Inhibition in Test Sample			
	Sample : *Costus pictus leaf extract*			
	Concentration in mL			
	0.25	**0.50**	**0.75**	**1.0**
Aspergillus niger	2 mm	4mm	6mm	8mm

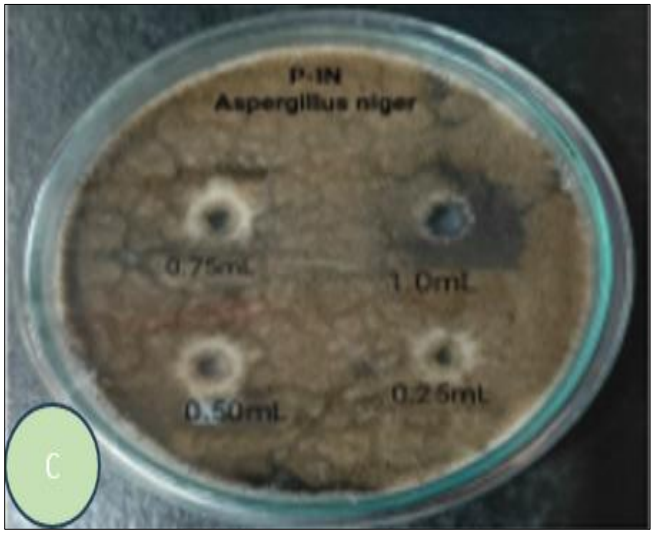


Fig (c): *A. Niger*

The study introduces new method for isolation, identification and characterisation of pharmaceutical constituents of *Costus pictus* leaf extract. The dried leaves of the selected plant were extracted by Soxhlet extraction using 90% ethanol. Purification of the extract was carried out by TLC. The presence of various phytoconstituents were confirmed by different chemical tests, FTIR, Fluorecence study and GCMS spectral studies. The extracts were also subljcted to antimicrobial and antdiabatic activities. FTIR and fluorescence studies confirmed the presence of different functional groups such as alcohols, phenolics, primary alcohols, alkanes, alkynes and ketones which might be a perfect product for any type of pharmaceutical applications. GC-MS spectra detected some bioactive compounds from ethanolic extract of *Costus pictus* leaves. The spectra of different constituents were confirmed with the spectrum of standard compounds of NIST library. The *Costus pictus* leaf extract has antibacterial activity against the pathogenic bacteria *S. aureus* (gram-ve) and *E. coli*. (gram +ve). Also, the leaf extract has antifungul activity against aspergillus niger. Moreover it shows 69.6% anti-diabatic activity. These findings are similary justfied by umerous research on indian tradtional plants with various parts and products to prove their potential and also commercialized in various levels in pharmaceurical industry [25, 26].

Conclusion

Medicinal plants are used for screening of the secondary metabolites in research institutes which proves to be helpful in pharmaceutical companies for manufacturing of new drugs for the treatment of various diseases and disorders. From this study, it can be concluded that the leaf of *Costus pictus leaf extract* contains different phytochemicals, which might be a perfect product for antidiabetic, antimicrobial activities.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Ethical approval

The authors declare no competing interests.

Abbreviations

GCMS: Gas chromatography-Mass spectrometry; FTIR: Fourier Transform Infrared Spectroscopy; NIST: National Institute of Standards and Technology; TLC: Thin layer chromatography; UV: Ultra-Violet; UV: Mw: Molecular weight; Mf: Molecular formula; nm: nano-meter.

References

1. Bailey CJ, Day C. Traditional plant medicines as treatment for diabetes. Diabetes Care. 1989;12:553-564.
2. Pari L, Umamaheswari J. Antihyperglycaemic activity of *Musa sapientum* flowers: effect on lipid peroxidation in alloxan diabetic rats. Phytother Res. 2000;14:1-3.
3. Garg S, Hari V, Suseela R, Menon S, Gaviraj EN, Tiwari KJ, *et al*. Studies on the effects of *Adansonia digitata* Lin's fruits on diabetes. J Adv Zool. 2023;44(S4):52-64. https://doi.org/10.17762/jaz.v44iS4.1655
4. Dakshayini PN, Roy UB, Kolgi RR, Singh SR, Sharma S, Shrivastava R, *et al*. Efficacy of phytoextracts on female reproduction and impact on diabetes mellitus. J Adv Zool. 2023;44(4):1154-1160. https://doi.org/10.53555/jaz.v44i4.3056
5. Mohamed B, Abderrahim Z, Hassane M. Medicinal plants with potential antidiabetic activity-A review of ten years of herbal medicine research. Int J Diabetes Metab. 2006;14:1-25.
6. Halberstam M, Cohen N, Shlimovich P. Oral vanadyl sulfate improves insulin sensitivity in NIDDM but not in obese non-diabetic subjects. Diabetes. 1996;45:659-666.
7. Modi R, Patil SJ. Stevia-A miracle for diabetes. In: The Handbook of Medicinal Plants & Health Care Systems. 1st ed. London-New Delhi: Integrity Media; 2023. p.39-46.
8. Bairagi JH, Haritha G, Yadav L, Garg S, Rani V, Pulipati S, *et al*. To study of *Artemisia nilagirica* leaves for their antithyroid, oxidative and antihyperglycemic properties. J Adv Zool. 2023;44(S4):40-51. https://doi.org/10.17762/jaz.v44iS-4.1654
9. Sharangouda, Patil SB. Phytochemical screening and antifertility activity of various extracts of *Citrus medica* (lemon) seeds in albino rats. Adv Pharmacol Toxicol. 2007;8(2):71-74.
10. Farnsworth NR. Biological and phytochemical screening of plants. J Pharm Sci. 1966;55(3):225-276
11. Harborne JB. Phytochemical Methods: A guide to modern techniques of plant analysis. London: Chapman and Hall; 1973.
12. Eramma N, Patil SJ. Exploration of the biomolecules in roots of *Flacourtia indica* (Burm F) Merr. methanol extract by chromatography approach. Lett Appl Nano BioSci. 2023;12(4):166.
13. Pimenta AM, Montenegro MC. Application of sequential injections analysis to pharmaceutical analysis. J Pharm Biomed Anal. 2006;40:16-34.

14. Haleshappa R, Patil SJ, Usha T, Murthy SM. Phytochemicals, antioxidant profile and GCMS analysis of ethanol extract of *Simarouba glauca* seeds. Asian J Biol Life Sci. 2020;9(3):379-385.
15. Bashyal J. Fluorescence spectroscopy: Principle, instrumentation, uses. Science Info. 2023. Available from: https://scienceinfo.com/fluorescence-spectroscopy-principle
16. Sunkara N, Anvitha G, Yamini G, *et al*. Review article on FTIR spectroscopy. Int J Creat Res Thoughts. 2022;10(12):IJCRT2212306. Available from: https://ijcrt.org/papers/IJCRT2212306.pdf
17. Reddy M, Chaturvedi A., Pharmacognosticaly studies of *Hhymenodictyon orixence* (Roxb.) Mabb. Leaf. Int. J. Ayurveda Res., 2010;1:103-105.
18. Giri S, Jamade PS, Pendakur B, Sanjotha G, Manawadi S, Binorkar SV, *et al*. Anticancer, antidiabetic, antioxidant properties and phytoconstituents of methanolic extract of *Euphorbia milii* leaves. Afr J Biol Sci. 2024;6(6):5419-5429.
19. Vishwanatha T, Pramod T, Lavanya L, Patil SJ. Medicinal plants of Himalayan region and their antimicrobial potential. In: The Handbook of Medicinal Plants & Health Care Systems. 1st ed. London-New Delhi: Integrity Media; 2023. p. 85-91.
20. Sreedharan S, Gothe A, Aier K, Kirankumar SV, Kumar KP, Patil SJ. Bioactive molecules and antimicrobial studies of *Rhus semialata* seeds. Res J Med Plants. 2020;13(1):10-17.
21. Ansari MM, Ahmad J, Ansari SH., Pharmacognostic evaluation of the stem bark of *Balanites aegyptica* delile "hingot". Hamdard medicus., 2006;50:82-94.
22. Reddy NVLS, Raju MG, Sowmika KV, *et al*. *in vitro* screening methods for antidiabetic activity: A comprehensive review. ISAR J Med Pharm Sci. 2024;2(2):1-10.
23. John C., Interpretation of infrared spectra, a practical approach. In: encyclopedia of analytical chemistry. R.A. Meyers (ed.). John Wiley and Sons Ltd; 2000;1-19.
24. Naira N. and Karvekar MD, Isolation of phenolic compounds from the methanolic extract of Tectona grandis. Res. J. Pharmaceutical. Biol. And chem. Sci. 2010;1(2): 221-225.
25. Karishma KB, Banu MA, Venkatesh CN, Prakruthi, Siddalingeshwara KG, Sadashiv SO, Patil SJ. Comparative analysis of phytochemical potential in ethanol extract of *Cosmos bipinnatus* and *Pteries fauriei* leaves. Adv Pharmacol Toxicol. 2023;24(1):25-32
26. Ajaykumar M, Gataraddi S, Mahadevappa P, Aladakatti RH, Patil SJ, Sadashiv SO. Biological activities of unripe fruit extract: Anti-inflammatory, antibacterial, anti-urease, and anti-α-amylase effects. In: Sawicka B, Messaoudi M, Rebiai A, editors. Biotechnology and Phytochemical Prospects in Drug Discovery. Singapore: Springer; 2025. https://doi.org/10.1007/978-981-96-2790-5_5