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A REVIEW ON COSTUS IGNEUS OR INSULIN PLANT

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ABSTRACT

Costus igneus Nak and Costus pictus D. Don, often known as Spiral flag, is a Costaceae plant native to South and Central America that has recently been imported into India. It is a perennial, erect, spreading plant that grows to about two feet tall, with spirally arranged leaves and lovely flowers. In southern India, it is commonly grown as a decorative plant, and its leaves are used as a food supplement in the treatment of diabetes.[1] Several studies have recently been conducted to assess the plant's anti-diabetic potential. Furthermore, it has been shown to have a variety of pharmacological effects, including hypolipidemic, diuretic, antioxidant, antimicrobial, and anti- cancerous properties. Furthermore, phytochemical studies reveal the presence of carbohydrates, triterpenoids, proteins, alkaloids, tannins, saponins, flavonoids, steroids, and trace elements. Thisarticle attempts to consolidate and investigate the various pharmacological and phytochemical investigations reported to date.[1]

KEYWORDS: The costus igneusInsulin plant, leaf, root, leaves, phytoconstituents, Major pharmacological activity. The effects of costus igneus on learning and memory, as well as health advantages, arediscussed.

INTRODUCTION

Costus igneus Nak (also known as blazing costus, Step ladder, Spiral flag, or Insulin plant) is endemic to South and Central America. This is a new arrival to India from America as a herbal remedy for diabetes, hence the widespread name 'insulin plant.'[1] It is commonly grown in gardens as a decorative plant in South India, but it also grows wild in many areas.[2]

In India, it isused to manage diabetes, and diabetics are known to consume one leaf every day to keep their blood glucose levels low.[3] The indigenous tribes of Kolli hills in Namakkal district, Tamil Nadu, used C. igneus leaves to treat diabetes.[4] In Mexican traditional medicine, the aerial component of C. pictus D. Don is used as an infusion to cure renal diseases.[5] The plant is a member of the Costaceae family. Nakai was the first to elevate the Costaceae to the family level due to its spirally arranged leaves and rhizomes' absence of aromatic essential oils. Costoideal was identified by Engler and Prantl as a Zingiberaceae subfamily prior to its elevation to family status. There are about 200 species in the four genera that make up the Costaceae family. The biggest genus in the family, Costus contains over 150 species, most of which are found in tropical regions.[2,6] The current review addresses contemporary studies conducted on Costus igneus Nak in the fields of phytochemistry, pharmacology, biological activity, and safety.[5]

Synonyms[5]

1. Spiral nag
2. Fiery Costus
3. Chamaecostus cuspidatus
4. Paisal

Source Biological[5]

It is made up of both fresh and dried leaves from the COSTUS IGNEUS plant (Costaceae family).

Geographic source[5]

The natural habitat of Costus igneus is southeast Asia, particularly the larger Sunda Islands in Indonesia. It is also present in West Bengal and other parts of India.

The plant is already being used as a food supplement to treat diabetes in southern India.

Goals[7]

The costus igneus plant, also referred to as spiral ginger or the insulin plant, is mostly prized

forits possible health advantages, especially in traditional medicine. These benefits frequently include.

1. Information handling
2. Inhibitory qualities
3. The role of antioxidant
4. Health of the digestive system
5. Research and development

Taxonomy[7]

Plant name:	Costus igneus N.E.Br.
Classification:	Eukaryota
Kingdom:	Plantae
Subkingdom :	Viridae Plantae
Phylum:	Tracheophyta
Subphylum :	Euphyllophytina
Class:	Liliopsida
Subclass:	Commelinidae
Superorder:	Zingiberanae
Order:	Zingiberales
Family:	Costaceae
Subfamily:	Asteroideae
Genus:	Costus
Specific Epithet:	Igneus

MORPHOLOGY

The highest stems of this perennial, spreading plant eventually topple over and lie on the ground.It grows to a height of about two feet. Simple, alternating, whole, oblong, evergreen leaves with parallel venation measure 4 to 8 inches in length. This tropical evergreen forms aesthetically pleasing, arching clusters from subterranean rootstocks with its huge, smooth, dark green leaves that have light purple undersides. In the warm months, gorgeous 1.5-inch-diameter orange flowers appear on cone-shaped heads at the tops of branches.[8] Fruits are green, less than 0.5 inches, unassuming, and not ostentatious.[8]

Development and Transmission

Spiral flags can grow in either direct sunlight or some shade. It is typically grown close to water and requires rich soil and lots of moisture. Division of the clumps, cuttings, or separation of theoffsets or plantlets that grow beneath the flower heads are the methods used for propagation.

Nematodes and mites can cause issues, particularly in light, sandy soil. There are no serious illnesses affecting the plant.[8]

Investigation of phytochemistry

Ascorbic acid, α-tocopherol, β-carotene, terpinoids, steroids, and flavonoids are among the antioxidant components found in C. igneus leaves, which were shown to be rich in protein and iron through sequential screening for phytochemicals.[10,9] Another study demonstrated that the greatest concentration of phytochemicals, including proteins, carbohydrates, triterpenoids, alkaloids, tannins, saponins, and flavonoids, was present in methanolic extract.[11] According to a preliminary phytochemical analysis, 21.2% of the leaves of the insulin plant (C. pictus) are made of fiber. 5.2% extractives in petroleum ether, 1.06% in cyclohexane, 1.33% in acetone, and 2.95% in ethanol were obtained from successive extractions. Steroids were found in every extract after a series of extracts were analyzed. There were alkaloids in the ethanol extract as well. Apart from α-tocopherol and ergastanol, a steroid, the main constituent of the ether fraction was bis (2'-ethylhexyl)-1,2-benzenedicarboxylate (59.04%).[12] Stem revealed the presence of the steroid molecule stigmasterol and the terpenoid compound lupeol.[13] The rhizome of C. igneus yielded the bioactive components quercetin and diosgenin, a steroidal sapogenin.[14] The elements K, Ca, Cr, Mn, Cu, and Zn are present in significant concentrations in the leaves and rhizomes of C. pictus, according to trace elemental analysis.[15] Clear, yellowish essential oils were obtained during steam distillation of the stems, leaves, and rhizomes of C. pictus D. Don.[9]

MAJOR CONSTITUENTS OF ESSENTIAL OIL

Stem oil (%)	Leaf oil (%)	Rhizome oil (%)
Hexadecanoic acid (28.3)	Hexadecanoic acid (24.51)	Hexadecanoic acid (25.26)
9,12-octadecadienoic acid (18.33)	2-pentanol (22.48)	9,12-octadecadienoic acid (7.74)
Dodecanoic acid (5.62)	Dodecanoic acid (3.96)	Dodecanoic acid (16.56)
Linalyl propanoate (6.03)	ß-ionone (8.69)	Tetradecanoic acid (10.20)
Tetradecanoic acid (4.82)	Farnesyl acetone (7.04)	Linalool (8.48)
A-eudesmol (3.55)	A- ionone (8.01)	α-terpineol (4.44)
γ-eudesmol (3.21)		
4-ethoxy phenol (3.06)		

Description of Plant

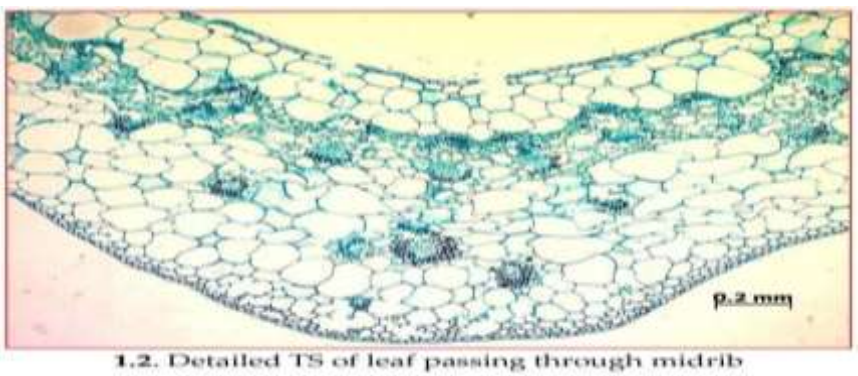
It is an upright-growing perennial plant that spreads outward and touches the ground. Simple, alternating, oblong, and evergreen, the leaves grow to a length of 4 to 8 inches and have parallel veining. Smooth, big, spiral-arranged dark green leaves with pale purple undersides adorn this tropical evergreen plant, which grows in clusters from subterranean rootstocks. During the warm months, it bears gorgeous orange blooms that measure 1.5 inches and resemble cones that emerge from the tips of branches 13. Being a rhizomatous shrub, the plant pierces the earth by itsunderground tuberous rhizome.[17] The fleshy, spongy, cylindrical rhizome has a smooth, pale brown surface that ranges in temperature from 30 to 40 degrees Celsius. It has a pleasing scent. It is native to South America and the states of Bahia and Espiritu Santo in eastern Brazil.

Additionally, North America, Asia, Australia, and Tropical Africa have reported seeing it. It was brought from America to India as a herbal remedy for diabetes. The regions of South India and Kashmir are home to Costus in India. Either full sun or some shade is suitable for spiral flag growth. It is generally planted close to a reliable source of water and needs rich soil and enough moisture. The offsets or plantlets that grow beneath the flower heads can be separated, divided into clumps, or removed as part of the propagation process. Nematodes and mites can frequentlybe a threat, particularly in light sandy soil. There are no illnesses that significantly hinder plant growth at the moment.[18]

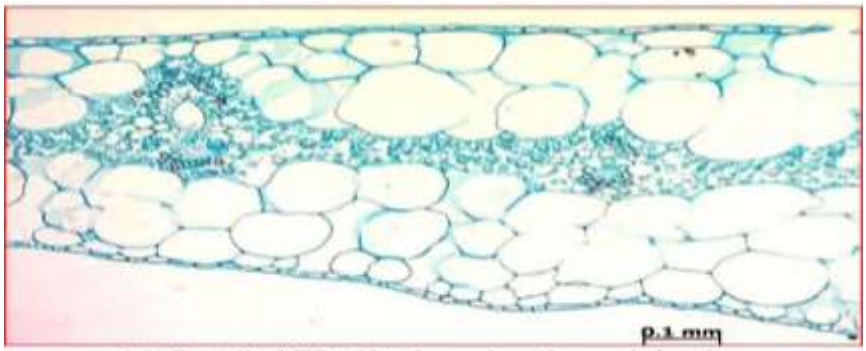
	
Insulin Plant	**Rhizome**
	
Stem	**Leaves**

Microscopy

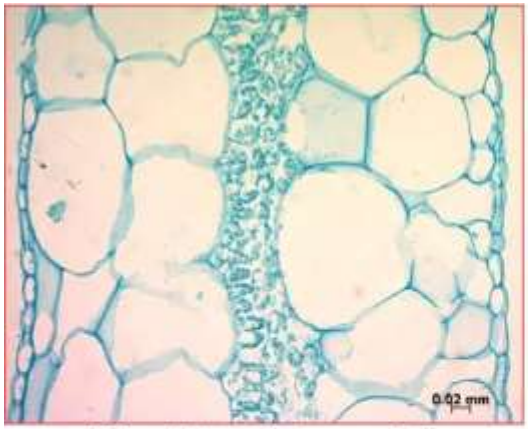
Upper and lower epidermis were seen in the C. igneus leaf's transverse section (T.S.). It has broad mesophyll tissue with a significant amount of big parenchymal cells. The fibrovascular bundles' continuous strands are being seen through them. In comparison to the lower epidermal cells, the upper epidermis cells are smaller. Stomata, which are frequently beaded with epidermal cells, are embedded in the lower epidermis.[19] The vascular bundles, which have either elongated or spherical cells, are discovered to be embedded in then-broken strands of chlorenchyma.[20] The core of the vascular bundles, which is encircled by phloem tissue, contains massive vessels. The bundles are discovered to be fibrous, loaded with calcium oxalate crystals in the shape of rosettes, and to have parenchyma next to them. Two arc-shaped patches made of thin-walled fibers guard the vascular tissue on either side. The lower side of the extravascular bundles in the midribs has a fibrous heath fashioned like a "U." The same anatomical characteristic, sagging extra-vascular bundles, is visible through the lamina in T. S.[21]



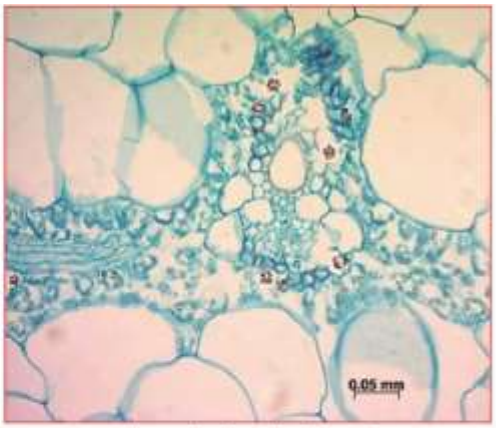
1.2. Detailed TS of leaf passing through midrib



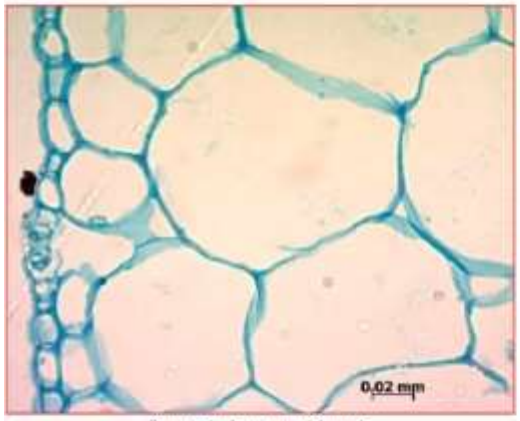
1.3. Detailed TS of leaf passing through lamina



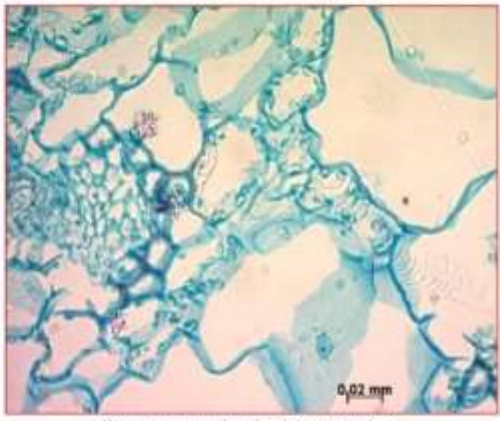
TS through lamina showing mesophyll



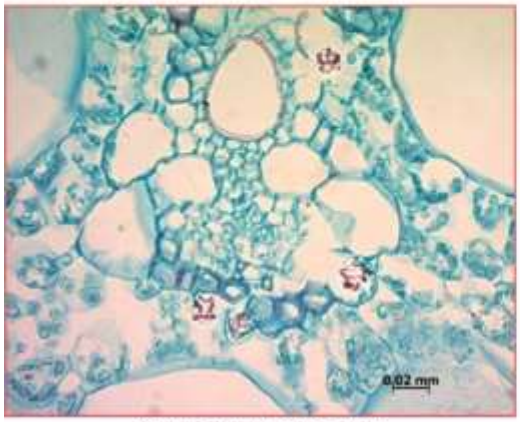
A vascular bundle enlarged



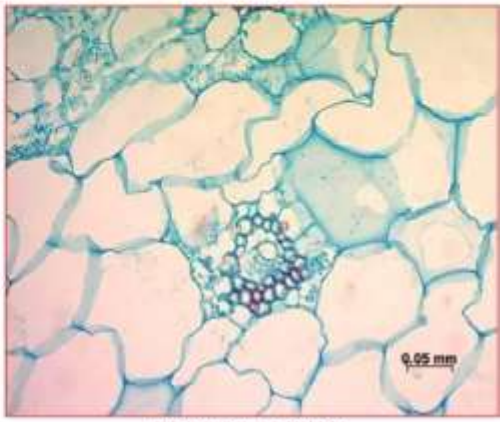
Stoma in lower epidermis



Rosette crystals of calcium oxalate



Crystal idioblasts with fibres



Fibro vascular bundle

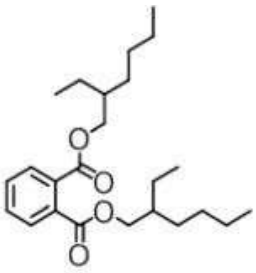
Plant-Based Components

Costus igneus has been shown to contain a variety of phytochemicals, including alkaloids, terpenoids, and flavonoids. The leaves, stems, rhizomes, and other parts of plants contain these bioactive substances. Leaves: 17 contain a variety of compounds, including proteins, carbohydrates, triterpenoids, alkaloids, tannins, saponins, and flavonoids. Furthermore, leaves include fatty acids (oleic acid, tetradecanoic acid, hexadecanoic acid, 9, 12-octadecanoic acid, ethyl oleate, and squalene) and carbohydrates (rose side).[18]

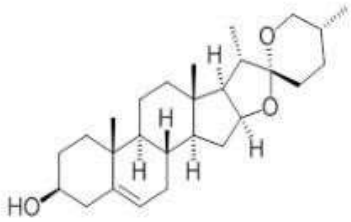
Stem: Stem 18 contains the terpenoid compound Lupeol and the steroid molecule Stigma Sterol.

Rhizome: Rhizomes 19, 20 contain quercetin, diosgenin, asteroidal sapogenin, and other compounds.

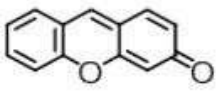
Root: Root section 14 contains terpenoids, alkaloids, tannins, and other compounds. High quantities of iron, protein, different antioxidants (ascorbic acid, α-tocopherol, β-carotene), steroids, terpenoids, and flavonoids were found in the phytochemical screening of C. igneus leaves.[19]



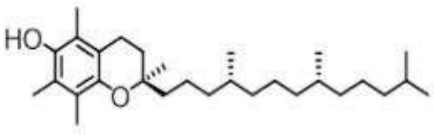
Bis (2'-ethylhexyl)-1,2- benzene dicarboxylate ($C_{24}H_{38}O_4$)



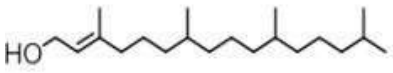
Diosgenin ($C_{27}H_{42}O_3$)



Xanthen-3-one ($C_{13}H_8O_2$)



α-Tocopherol ($C_{29}H_{50}O_2$)



Phytol ($C_{20}H_{40}O$)

Octacosane ($C_{28}H_{58}$)

Principal actions in pharmacology

antidiabetic properties

Recently, a great deal of study has been done to assess the insulin plant's ability to prevent diabetes. A tabular summary of the conducted animal experiments is provided. Patients who consumed one fresh leaf or one teaspoon of C. igneus powder per day, together with other treatment modalities, efficiently produced glycemic control in diabetics, according to a cross-sectional clinical trial. To investigate GLUT4 translocation and glucose uptake activity, an in vitro investigation using an ethanolic extract of C. pictus leaf was conducted; however, at a dose of 300 µg/ml, which is comparable to that of insulin and metformin, there was no direct peripheral action observed.[32] The efficacy of a tea produced from C. spicatus leaves to modify glucose homeostasis in C57BLKS/J (KS) db/db mice—a model of obesity-induced hyperglycemia—with progressive beta-cell depletion was assessed in this study. After the 10-week trial period, intraperitoneal (IP) insulin tolerance tests revealed that drinking C. spicatus teadid not change insulin sensitivity. This finding suggested that tea brewed from C. spicatus leaveswas ineffective at treating obesity-induced hyperglycemia at the provided dose.[18]

Study of toxicity

Studies on the acute toxicity of varying dosages of C. pictus aqueous extract (5, 10, 20, and 40 g/kg body weight) were conducted. This extract did not result in any behavioral abnormalities or death at any of the doses tested. According to acute toxicity experiments, all of the animals survived the test period and there was no influence on their general behavior after receiving 1 g/kg b.w./day of aqueous extract for 30 days. The administration of an ethanolic extract of C. igneus leaves at doses ranging from 50 mg/kg b.w. to 5000 mg/kg b.w. showed no significant toxicity signs during the first four hours and was followed by daily observations for 14 days, with no mortality; the drug was found to be safe at the tested dose level of 5000 mg/kg b.wt.[20] However, in a study on the methanolic extract of C. igneus, the results showed toxicity at 250 mg/kg body weight. In another study, palmitic acid was discovered to be the primary component in the stem, leaf, and rhizome oils of C. pictus. Palmitic acid has been shown to cause myofibril degeneration in healthy adult rat cardiomyocytes, increase the LDL to HDL cholesterol ratio, andserve as a key precursor for the development of coronary heart disease. As a result, using C. pictus leaves as a diabetic treatment on a regular basis may result in major heart problems and is not suggested.[20]

Diuretic effect

A study was conducted to determine the diuretic effect of an aqueous extract of C. pictus D. Don at doses of 100 and 200 mg/kg body weight, and to compare it to that generated by furosemide at 4 mg/kg. The results showed that C. pictus has a natriuretic effect similar to furosemide. The aqueous extract increased salt and potassium clearance similarly to furosemide, indicating that it constitutes considerable diuresis.[18]

Antioxidant Action

An in vitro investigation of alcoholic extracts from C. mexicanus leaves revealed moderate antioxidant activity.[16] The antioxidant activity of leaves and rhizomes in methanol, water, ethanol, and ethyl acetate extracts was evaluated using various models, including DPPH, β-carotene, Deoxyribose, superoxide anion, reducing power, and metal chelating assays at various doses. C. pictus leaves and rhizomes demonstrated 89.5% and 90.0% antioxidant activity, respectively, when compared to standard BHT (Butylated Hydroxy Toulene) (85%) at 400 µg/ml. The results showed that methanolic extracts of C. pictus leaves and rhizomes had strongerantioxidant activity than other extracts. Another study found that methanolic leaf extract of C. pictus D. Don increased superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase, vitamin A, vitamin C, vitamin E, and reduced glutathione, suggesting that it may be effective in reducing oxidative stress and free radical-mediated diseases. This plant's antioxidant properties may be attributed to the presence of phenolic compounds. In vitro, methanolic extracts of C. pictus flower and stem exhibit antioxidant action against oxidative protein damage.[Among the extracts examined, the chloroform extract of C. pictus D. Don bark exhibited excellent antioxidant activity. The oral administration of an ethanolic extract of C. igneus rhizome at 200 mg/kg body weight to diabetic rats for 30 days resulted in a strong antioxidant effect. The plant's bioactive compounds, quercetin and diosgenin, shown antioxidant activity sufficient to reverse oxidative stress in diabetic rats' liver, pancreas, and kidneys, as well as stimulate glycolytic enzymes and control gluconeogenesis.[20]

Antimicrobial Activity

The methanolic extract of C. igneus exhibited the highest antibacterial activity against gram-positive Bacillus cerus, Bacillus megaterium, Micrococcus leuteus, Staphylococcus aureus, Streptococcus lactis, and gram-negative strains Pseudomonas aeruginosa, Escherichia coli, Enterobacter aerogenes, Klebsiella pneumoniae, and Salmonella typhimurium. The isolated component from the ethanolic extract of Costus igneus had modest antibacterial and

antifungal action against Staphylococcus aureus, Eschericia coli, and Candida albicans. Methanolic extractsof C. pictus stem and flower showed the highest inhibitory action against Shigella flexneri, Klebsiella pneumonia, Bacillus subtilis, and Escherichia coli at a concentration of 150 µg/ml.[19]

The impact of Costus igneus on learning and memory

Shalini Adiga et al. (2014) evaluated the effect of Costus igneus on learning and memory in normal and diabetic rats using the passive avoidance test at doses of 250 and 500mg/kg ethanolic extract. A single intraperitoneal dosage of streptozotocin (35mg/kg) produced diabetes. After the 30-day study period, the blood glucose level was assessed, and the rats were submitted to a passive avoidance test. Treatment with Costus igneus dramatically reduced blood glucose levels in diabetic patients in a dose-dependent manner (75.70% reduction for 500mg) as compared to the diabetic control group. However, there was no significant response in non-diabetic rats, who had identical normal values. The rats were subjected to three acquisition trials. The diabetic ratstreated with Costus igneus took less time to move into the dark compartment, indicating that their innate behavior was preserved, as well as an improvement in their learning tendency, whereas the non-treated diabetic rats showed deterioration in the passive avoidance test.

Furthermore, treatment with Costus igneus extract in their post-shock retention experiment conducted after 24 and 48 hours indicated a significant increase in movement towards the entrance and a decrease in the duration of time spent in the darkroom. As a result, the thanolic extract of the Costus igneus plant effectively improves diabetic rats' learning and memory.[21]

The health advantages of the insulin plant[22]

- Insulin plant for diabetes
- Helps lower cholesterol levels
- Maintains kidney health
- Cures liver illness
- Maintains bladder health
- Boosts immunity
- Prevents cancer
- Cures asthma
- Reduces blood pressure
- Reduces bronchitis symptoms

- Used as a sore throat therapy
- Insulin plant for skin diseases.

CONCLUSION

Medicinal plants provide safer and more inexpensive alternatives

- Conventional medicines are expensive and often have negative side effects.
- The anti-diabetic impact of their leaves is currently being investigated in diabetic patients
- Medicinal plants are more effective than traditional treatments.
- Insulin plant leaves (costus igneus) lowered fasting and postprandial blood sugar levels in ratswith dexamethasone-induced hyperglycemia, returning them to normal levels.

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