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Research Article

Costus igneus Plant: With Their Therapeutical Values Other Than Anti-Diabetic Effect

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ABSTRACT

Analyzing herbal medications is necessary for the acceptance and globalization of Ayurveda. Ayurveda's quality is supported by science when the physiochemical value of its herbs is accurately and completely assessed. To establish such fundamental analytical values for the therapeutic anti-diabetic herb. i.e., costus igneus, this work is done. Additionally, it has been demonstrated that costus igneus is not only about anti-diabetic but also have a number of pharmacological properties, including hypolipidemic, hypoglycemic, anti-oxidant, anti-microbial, and anti-urolithiac activities. The current work enables researchers to clarify chemical compounds present in costus igneus with their medicinal properties.

INTRODUCTION

Natural products are an excellent source of complex chemicals, possessing a wide variety of biological activities and having a great potential therapeutic value(1). Higher plants are major sources of therapeutic agents and extensively utilized throughout the world in traditional as well as modern system of medicine(2). According to the World Health Organization, 80% of the world's population uses extracts or their active constituents in traditional medicines. In India, there are over 45,000 plant species, many of which are very structurally diverse and have the ability to create enormous quantities of organic compounds(3). According to the WHO, between 70% and 80% of Indians rely on Indian systems of treatment such as Unani, Siddha and Ayurveda(4). One of the most significant sources of medications are comes from plants. The majority of medications used today are derived from plants, including morphine from papaver somniferum, Ashwagandha from withania somnifera, ephedrine from ephedra vulgaris, and atropine from Atropa belladonna and many more(5). Due to their

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efficacy, affordability and safety, herbal medications play a significant role in the world(4).

Figure No.01: Costus igneus Plant

The Indian medicinal systems use plants to varying degrees

Ayurveda : 2000
Siddha : 1300
Unani : 1000
Tibetan : 500
Modern : 200
Folk : 4500
Homeopathy : 800

In traditional and folk medicine in India, there are about 25,000 active plant-based formulation(4). There are 250,000 kinds of flowering plants that are classified as therapeutic plants in total. The World Health Organization (WHO) classified about 21,000 different types of therapeutic plants. The current annual value of the worldwide herbal market is over US $62 billion. The herbal market is anticipated to expand by 15% annually and reavh $5 trillion in global sales by 2050(5). Before the development of modern science, sustaining human health was greatly helped by the traditional usage of herbal medicine, which has been used in medical practice for thousands of years and is typically an intrinsic part of cultures around the world(4). However, the WHO states that "additional research is needed to establish the efficacy and safety" of a number of procedures and medicinal plants utilized by conventional medicinal systems(4).

Costus igneus plant

Traditional medicinal plants play important role in a significant source of contemporary physiologically active compounds(6). The family costaceae includes costus igneus. A species of herbaceous plant in the costaceae family called costus igneus is also known as "Fiery Costus" or "Spiral Flag"(6).

Origin of costus igneus plant

It is a native of South and Central America. It is also known by the synonyms costus pictus D.don, costus mexicanus liebm or costus congenitus, commonly called "insulin plant"(7). The Greater Sunda Islands in Indonesia are where the insulin plant originally originated in southeast Asia. It is a plant that originated in South Central America and is relatively new to India(8). Costus is cultivated in regions like Kashmir and the Himalayas for its root. It belongs to the family costaceae, though it was originally classified under zingiberacea.

costus igneus in Indian regions

It can be found in India and other regions for its medicinal and ornamental value(9). In Maharashtra, the costus igneus plant is known as the insulin plant. It grows in gardens as an ornamental shrub in India. Kerala has employed it as an attractive plant. Diabetes is traditionally treated with herbs by chewing plant leaves for at least a month to achieve to controlled blood glucose level(8). In traditional medicine, it's also employed to promote long life, treat rashes, lower fever, treat asthma, treat bronchitis and get rid of intestinal worms. It is endorsed by allopathic doctors as well. Patients with diabetes are recommended to chew an insulin plant leaves for a month as part of Ayurvedic treatment. The patient has to take two leaves per day in the morning and evening for one week(10). The leaves must be thoroughly chewed before being ingested. The patient should take one leaf in the morning and one in the evening, for 30 days, this dosage should be taken daily(10).Due to its anti-diabetic qualities,

this plant is growing in popularly(6). The present study aimed at studying the phytochemical analysis of costus igneus plant and their major therapeutic activities.

Morphology of costus igneus plant

Tropical, upright, perennial plant belonging to the costaceae family is called costus-igneus. It is a tasty perennial herb that grows to a height of 2.7metres and has an upright stem(9). It has simple, alternating, whole, oblong, evergreen leaves that range in length from 4 to 8 inches and have a parallel venation system. The tree's enormous, velvety, dark-green leaves are spirally coiled around the stems in elegant, arching bunches that emerge from underground rootstocks(7). The leaves have light purple undersides. It can grow to a maximum height of 60cm, with the tallest stems toppling and laying on the ground. On cone-like heads at the ends of branches, stunning orange blooms with a 2.5-12.5 cm diameter are produced on hot days. Stem cutting is used in the multiplication of insulin plants. Common names include Insulin plant, Stepladder, Fiery Costus, Spiral Flag and Spiral Ginger(8).

Anatomy of Rhizome:

The rhizome has a smooth, flat surface and is round. It has an epidermal layer that is fairly distinct and made up of cells with thin walls and narrow oblong shapes. Wide cortical cells that are thin-walled, compact and have a wide-spread structure make up the interior of the cortex(11). Quercetin, Diosgenin, a steroidal Sapogenin, etc. are available in rhizome(4).

Anatomy of Leaf:

The leaf is thin, isobilateral and has no variation between the upper and lower sides. It also features smooth, even surfaces. The leaf has four layers of wide, tangentially oblong, thin-walled mesophyll cells in addition to two layers of thin epidermal cells. There are rows of tangentially flat thin-walled cells in both epidermal layers. They are 10 to 20 m thick. Mesophyll cells range in thickness from 100 to 140 m. These noticeable vascular bundles are located in the lamina's median region(11).

Anatomy of Root:

Thin roots have a thin homogenous parenchymatous cortex and a rather large superficial sequent periderm. Older thick roots have periderm that is a little wider and made up of polyhedral, randomly oriented cells with thin walls(11). Terpenoid, Alkaloids, Tannins, etc. are available in root portion(4). Costus igneus root has been employed in the siddha medical system as powder (chooranam), decoction (Kudineer) and the oil (thylam)(12). Terpenoid compound, Lupeol and Steroid compound Stigmasterol are present in the stem(4).

Taxonomy

Table No.01: (Taxonomy of costus igneus)(7)

Botanical Name:	Costus igneus
Domain:	Eukaryota
Kingdom:	Plantae
Sub-kingdom:	Viridaeplantae
Phylum:	Tracheophyta
Sub-phylum:	Euphylophitina
Infra-phylum:	Radiotopses
Class:	Liliopsida
Sub-class:	Commelinidae
Superorder:	Zingiberane
Order:	Zingiberales
Family:	Costaceae
Sub-family:	Asteroideae
Tribe:	Coriopsidae
Genus:	Costus

Major compounds of costus igneus with their therapeutic activities

Phenol

Table No.02: (Applications of Phenol)

Production of chemicals:	In the production of various compound including oils, aspirin, antiseptic, pharmaceuticals, dyes and pesticides.

Phenolic resins:	Resins are vital component in manufacturing process due to their adhesive and insulating properties.
Bisphenol A and caprolactam production:	Phenol is the precursor in the production of Bisphenol A and caprolactam.
Medical applications:	In production of antiseptics, lotions, ointments, mouthwashes and salves. Its antiseptics properties make it useful in the healthcare industry for disinfection purpose.
Minor Uses:	In the production of paint, tanning dyes, lacquers, perfumes and inks(13).

Cardiac glycosides

Table No.03: (Applications of Cardiac glycosides)

Cardiovascular action:	blockage of heart's sodium potassium ATP'se, with positive inotropic effect. Digoxin is approved by the Food and Drug Administration (FDA) for the treatment of heart failure and arrhythmia in human and veterinary medicine.
Pharmaceutical market:	for oral and intravenous administration as an elixir, capsule, pill, and ampoule(14).
Induction of apoptosis:	cardiac glycosides have been observed to induce apoptosis or programmed cell death, in different type of cells including cancer cells.
Anti-cancer potential:	Cardiac glycoside acts as a potential agent for cancer treatment(15).

Triterpene

Table No.04: (Applications of Triterpene)

Mechanism of action:	inhibition of intracellular signal molecule and transcription factors. They regTriulate process like tumor cell proliferation, survival, invasion, angiogenesis, metastasis, chemo-resistance and radio-resistance.
Anti-cancer activity:	chemo-preventive and therapeutic effect against various cancers including colon, breast, prostate and melanoma. They inhibit tumor growth, angiogenesis and induce apoptosis in tumor cells.
Anti-oxidant activity:	neutralizing free radicals and preventing oxidative damage.
Neuro-protective properties:	Protecting neuronal cells from damage induced by oxidative stress.
Anti-hypertensive effect:	Inhibition of platelet aggregation and promotion of endothelial-dependent vasodilation(16).
As potentially cytotoxic compound:	cytotoxic properties against tumor cells at low activity towards normal cells(17).

Tannin

Table No.05: (Applications of Tannin)

In various Industry:	**Food Industry:** Primary component of foods, because of their beneficial effects on the food as antibacterial, antioxidants, packaging materials and food additives(18). **Wood Industry:** The organic acids, tannins, and lignocellulosic material found in wood make it particularly vulnerable to agents that cause biological degradation(18).
Anti-oxidant and free radical scavenging property:	To scavenge cellular and molecular free radicals, particularly in pro-oxidant situations, and limit lipid peroxidation.
Anti-viral activity:	Adenoviruses, enteroviruses, caliciviruses, rotaviruses, influenza virus A, rhabdoviruses, paramyxoviruses, and human immunodeficiency virus.
Cardio-protective:	anti-ischemic, vasorelaxant, myocardial infarction, and histamine release inhibitory effects.

Anti-diabetic activity:	To lower blood sugar levels by postponing intestinal glucose absorption. Control the pancreatic beta-cells for antioxidants and postpone the onset of insulin-dependent diabetes mellitus.
Anti-inflammatory activity:	It has potent anti-hyaluronidase and anti-elastase activity as well as associated anti-inflammatory effects(19).

Carbohydrate

Table No.06: (Applications of Carbohydrate)

Anti-cancer:	Carbohydrate (glucose or other glucose transporter substrates) have been conjugated to cytotoxins or anticancer medicines.
As scaffolds:	For building bioactive molecules by adding desired substituents at specific locations around the sugar ring due to their high functional group orientations. This approach has been widely used in the design of peptidomimetics.
For vaccines:	In anti-cancer and anti-bacterial vaccines. e.g., star drug prevnar-13 is a typical polysaccharide protein conjugate vaccine.
In combination:	Nanotechnology and glycochemobiology combined to create new tools that used in drug targeting, photodynamic, cancer cell imaging and biosensor(20).

Alkaloid

Table No.07: (Applications of Alkaloid)

Anesthetic agents(21).	Antitussive
Antidote to nerve gas poisoning	Anti-bacterial showing antiplaque activity(22).
antiarrhythmic	Asthma, bronchospasm
Bacillary dysentery	Mamma and ovary carcinoma
analgesic	Antiprotozoal
Local anesthetic	Expectorants
Gout remedy	Antitussive
Central nerve system stimulant	Miotic in treatment of glaucoma, leprosy
Antihypertensive, tranquilizer	Anti-smoking
Anti-asthmatics	Chemotherapy(23).

Terpenoid

Table No.08: (Applications of Terpenoid)

Flavor-enhancing property:	diverse range of potential medicinal benefits and flavor-enhancing properties.
Rubber:	Rubber is the most well-known terpene, is a poly-terpene made up of isoprene repeating subunits(24).
Immunoregulation:	help regulate the immune system's response.
Anti-oxidation:	neutralize harmful free radicals in the body and protect against oxidative stress-related damage. e.g., limonene and menthol
Neuroprotection:	Certain terpenes, including pinene and limonene, protect against neurodegenerative diseases like Alzheimer's and Parkinson's(24).
Anti-tumor:	β-caryophyllene and linalool, have been studied for their inhibit tumor growth and induce apoptosis (programmed cell death) in cancer cells.
Anti-inflammatory:	myrcene and α-pinene may help alleviate inflammation-related conditions such as arthritis and inflammatory bowel disease.

Anti-malarial:	Certain terpenes, such as artemisinin derived from artemisia annua(sweet wormwood), are used in the treatment of malaria.
Cardiovascular diseases:	Terpenes like β-sitosterol have been studied for lowering cholesterol levels and improving blood circulation.
Hypoglycemic activity:	limonene and carvone, have been investigated for their potential to lower blood sugar levels, making them promising for managing diabetes(25).
Other significant terpenes:	a. Camphor b. Menthol c. Pyrethrins (insecticides) d. Hecogenin(detergent), etc.(24).

Protein

Table No.09: (Applications of protein)

Utilization:	To make hemoglobin, enzymes and hormones, can also use proteins as fuel(26).
In obese patients:	Whey protein has a positive impact on glucose metabolism. Helps protect against type 2-diabetes and other conditions linked to fat buildup.
Insulin secretion:	Decreases insulin resistance(27).

Major therapeutic activities of costus igneus

Table No.10: (Major therapeutic activities of costus igneus)

Name of the compounds	Activities
Phenol (catechin)	Inhibit alpha-glucosidase activity and anti-oxidant activity
Triterpenoid (corosolic acid)	Glucose uptake activity
Insulin like protein	Hypoglycemic activity

Anti-oxidant activity

Foods rich in antioxidants play an important role in the prevention of cardiovascular disease, cancer, neurodegenerative diseases, inflammation and other problems caused by cell and cutaneous aging. Antioxidants offer protection against oxidative stress by scavenging the free radicals, inhibiting the lipid peroxidation and by other mechanisms(28). Antioxidants are naturally occurring plant compounds that shield the body harm from dangerous chemicals known as free radicals. They do this by assisting in the prevention of oxidation, which can destroy cells and possibly speed up ageing(29). The comparative analysis of the antioxidant activity of costus igneus's leaf, stem and rhizome. In comparison to the stem and rhizome, the antioxidant activity in the leaf was the lowest. In comparison to leaf, which displayed 72% antioxidant activity and stem, which displayed roughly 55% antioxidant activity, rhizome displayed a maximum of 89% antioxidant activity(29). In comparison to the positive control doxorubicin, the acetone extract of costus igneus exhibited the strongest cytotoxic action on the cancer cell line (MCF-7). In biological applications, costus igneus can be used safely and

effectively. It also has effective cytotoxic potential(30).

Anti-diabetic Activity

In a cross sectional clinical study, patients consuming either one fresh leaf or 1 teaspoon of shade-dried powder per day of costus igneus in conjunction with other modalities of treatment had effectively produced glycemic control in diabetics(7). Other therapeutic effects of this plant include lowering diabetic-related problems, stabilizing renal and hepatic parameters, reducing glycosylated hemoglobin levels, boosting weight and insulin levels and exhibiting appreciable improvable in diabetic patients histopathological examinations(8).

- Tri-terpenoids: Tri-terpenoids work by primarily inhibiting the activity of alpha-glucosidase and alpha-amylase, which postpones the absorption of carbohydrates in the intestine and lowers the level of postprandial insulin.
- Protein: The insulin-like protein in costus igneus lowers blood sugar levels(4).

Studies carried out to evaluate anti-diabetic effect of costus igneus(7).

Table No.11: (Studies carried out to evaluate anti-diabetic effect of costus igneus)

Author, year	Model	Part/extract used	Results
S P Dhanabal, 2007	Normoglycemic and Hyperglycemic rats	200, 400 mg/kg b.w. of ethanolic leaf extract	400mg/kg b.w. of extract led to significant blood glucose-lowering effect in hyperglycemia rats.
V Devi, Asna Urooj, 2008	STZ induced in male albino Wistar rats	500 mg/kg b.w. of crude leaf powder, orally for 15days	Leaf powder is effective in lowering blood glucose.
Akhila J Shetty, 2010	Dexamethasone in male albino Wistar rats	100, 250, 500 mg/kg b.w. leaf powder, orally for 7 days	250, 500 mg/kg leaf powder reduced the fasting and post-prandial blood sugar levels, bringing them to normal.
V Devi, Asna Urooj, 2011	STZ Induced in male albino Wistar rats	500 mg/kg b.w. of leaf powder for 45 days	Consistent and gradual decrease in blood glucose levels.
S Suganya, 2012	Alloxan induced in female albino Wistar rats	200 mg/kg b.w. of aqueous extract, orally for 30 days	Reduced the levels of blood glucose, lipid profile, lipid peroxidation, liver marker enzymes, urea, creatinine and increased the anti-oxidant enzymes.
M V Kumudhavalli, 2012	STZ induced in male albino Wistar rats	250, 500 mg/kg b.w. each of aqueous and ethanolic leaf extract, orally for 15 days	500mg/kg of both aqueous and ethanolic extract showed significantly reduced the blood glucose level and lipid profile. While 500mh/kg of ethanolic extract was more significant than the aqueous extract.
R Remya, M Daniel, 2012	Alloxan induced in male Sprague Dawley rats	200, 400 mg/kg b.w. of fresh leaf extract, orally for 60 days	Decrease in blood glucose level and lipid profiles.

Hypoglycemic Activity

ILP (Insulin like protein) a new protein with hypoglycemic action, was purified from costus igneus(31).

In streptozotocine-induced diabetic rats, the aqueous extract of costus igneus and costus pictus exhibits strong hypoglycemic action(31). The ILP has good therapeutic potential because it had a hypoglycemic impact that persisted for more than 1 hour after application(32). Using the insulin-responsive cell line RIN 5f in an in-vitro experiment, the ILP(Insulin like protein) demonstrated hypoglycemic action. Interesting, when given orally during an oral glucose tolerance test, ILP exhibited a considerable drop in glucose levels(32).

RESULT AND DISCUSSION

The current work clarify chemical compounds present in costus igneus with their medicinal properties. The costus igneus often known as the 'insulin plant', contains potent medicinal and therapeutic chemicals, which has other than Anti-diabetic properties. The presence of such chemicals can be used in preparing various medicinal formulations which can be majorly act as Anti-oxidant, Anti-diabetic and Hypoglycemic activity. The current work enables to clarify chemical compounds present in costus igneus with their medicinal properties can be used in research. Morphological characteristics of costus igneus were studied. The major compounds containing like Phenol, Cardiac glycosides, Triterpene, Tannin, Carbohydrate, Alkaloid, Terpenoid and Protein presence methods were studied. costus ignues containing major compounds with their pharmacological activities and major therapeutic activities of costus igneus with some available marketed products were studied.

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