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Review Article

Costus Ignus: Insulin Plant And It's Preparations As Remedial Approach For Diabetes Mellitus

Ganesh Mohan Samgir * , Ganesh Anil Gaikwad , Priyanka Yewale

Department of Advance Herbal Drug Technology Navsahyadri Institute of Pharmacy Naigaon, Pune, Tal. Bhor, 412213

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ABSTRACT

The plant Costus igneus, sometimes referred to as the insulin plant, has long been known for its anti-inflammatory, anti-oxidant, anti-proliferative, anti-urolithiasis, hypolipidemic, neuroprotective, and antimicrobial properties. The anatomical and morphological studies of Costus igneus, including its potential medical applications, are the focus of this paper. This plant's secondary metabolites, which mostly exhibit anti-diabetic effect, include b-sitostirol, corosolic acid, diosgenin, quercetin, catechine, and oleic acid. As of right now, Costus igneus may be distinguished from other members of the Costaceae family by its distinctive morphological, anatomical, and proximal traits. Using a variety of search engines, including Pub Med, Science Direct, and Google Scholar, among others, this review paper gathered data with a primary focus on written English publications. The goal of this review article is to investigate the medicinal qualities of the insulin plant, Costus igneus, as well as the mechanisms by which all major phytoconstituents act to prevent diabetes for the benefit of future research and the creation of appropriate formulations for the benefit of humankind.

INTRODUCTION

Costus igneus is a medicinal herb from the Costaceae family that is also known as the Insulin Plant because its leaves assist the human body produce insulin. Nowadays, the Insulin plant is a highly sought-after ayurvedic plant that is widely used as a therapeutic herb. Consuming the leaves of this plant is thought to lower blood glucose levels, with diabetics reporting a decrease. Insulin plants are native to Southeast Asia, notably the Greater Sunda Islands in Indonesia. This plant is new to India from South Central America and has been used as an ornamental plant in Kerala. Herbal treatments for diabetes typically involve chewing plant leaves for at least a month to reduce blood glucose levels.

***Corresponding Author:** Ganesh Mohan Samgir
Address: *Department of Advance Herbal Drug Technology Navsahyadri Institute of Pharmacy Naigaon, Pune, Tal. Bhor, 412 213*
Email : ganeshsamgirofficial@gmail.com

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FIG. 1: Picture of Insulin Plant and its leaves part

Figure 1 depicts the insulin plant and its leaves (part 1). The plant "Costus Pictus," often known as the insulin plant, has an antidiabetic effect. However, it is not suggested to use C. pictus leaves for diabetic treatment due to the risk of cardiac illness.

Morphology of the Plot-

Costus igneus is a tropical, perennial, straight plant belonging to the Costaceae family. It has evergreen leaves that are simple, alternating, whole, and oblong in shape, measuring 4-8 inches long and with a parallel venation system. The tree's huge, dark green, velvety leaves have light purple undersides and spiral around the stems to produce elegant, arching underground rootstocks. clusters originating from Maximum have a height of 60 cm, with the tallest stems falling over and laying on the ground. On hot days, beautiful orange blooms with a diameter of 2.5-12.5 cm appear on cone-shaped heads at the ends of branches. Insulin plant propagation involves stem cutting. Common names include Fiery Costus, Spiral Flag, Insulin Plant, Step Ladder, and Spiral Ginger.

Binomial Name:

- Chamaecostus cuspidatus Synonyms:
- Costus cuspidatus (Nees & Mart.)
- Costusigneus N.E.Br
- Globba cuspidate Neet & Mar

Taxonomic Position:

Botanical name- Costusigneus

Domain	-	Eukaryota
Kingdom	-	Plantae
Subkingdom	-	Viridaeplantae
Phylum	-	Tracheophyta
Subphylum	-	Euphylophitina
Infra-phylum	-	Radiotopses
Class	-	Liliopsida
Subclass	-	Commelinidae
Superorder	-	Zingiberane
Order	-	Zingiberales
Family	-	Costaceae
Subfamily	-	Asteroideae
Tribe	-	Coriopsidae
Genus	-	Costus
Specific epithet	-	Igneus

Active Compounds (Anti-Diabetic):

These plant components include a variety of phytochemicals, including terpenoids, alkaloids, and flavonoids. This herb has long been used in India to treat diabetes in both experimental diabetic rats and humans. Several plant parts, including leaves, stems, rhizomes, and roots, contain biocomponents 6, 11. These include proteins, carbohydrates, triterpenoids, alkaloids, tannins, saponins, and flavonoids in leaves. Additionally, this plant's leaves include fatty acids such as hexadecanoic acid, 9, 12-octadecanoic acid, tetradecanoic acid, ethyl oleate, oleic acid, and squalene, as well as carbohydrates such rose oxide 12. Stems contain steroids such as stigmasterol and terpenoids such as lupeol. Rhizome 13 contains quercetin, diosgenin, a steroidal sapogenin, and other compounds. The root section contains terpenoids, alkaloids, tannins, and other compounds.

Chemical Nature:

Triterpenoids: Triterpenoids, such as β-carotene, corosolic acid / glucoseyl, lupeol, and glycyrrhetinic acid, are compounds that contain three terpene units or six isoprene units.

Steroids:

βsitosterol, an organic molecule with four rings organized in a certain molecular structure, is a physiologically active substance. such as stigmasterol,

Alkaloids:

Alkaloids are plant compounds that contain nitrogen and have both heterocyclic and non-heterocyclic chemical structures. However, there are no noteworthy alkaloids found in Costus igneus.

Phenols:

Phenols are chemical substances, such as catechin and strychnine, that have a hydroxyl group directly connected to an aromatic hydrocarbon group.

Flavonoids:

Known as effective free radical scavengers, flavonoids are a class of hydroxyl polyphenolic phytoconstituents that have generated a lot of interest as potential treatments for diseases caused by free radicals, including diabetes mellitus. These are derivatives of benzogamapyrones, such as quercetin, cinchona, epicatechin, and epigallocatechin gallate.

Proteins:

Proteins are big macromolecules made up of lengthy chains of residues from amino acids; an example of a protein is an insulin-like protein.

Fatty Acid:

Fatty acids, such as hexadecanoic acid, 9, 12 octadecanoic acids, tetradecanoic acid, ethyl oleate, and oleic acid, are long aliphatic chains that can be saturated or unsaturated. the complete list of phytoconstituents found in insulin plant leaves.

Pharmacological Activities:

Numerous studies have led to the conclusion that the insulin plant has a wide range of medicinal uses. Some of them have not yet been thoroughly examined. Numerous plant components, including the leaf, stem, root, rhizome, and entire plant, exhibit these medicinal qualities. The fundamental hypoglycemic potential is enhanced by leaves. The plant's stem has primarily been linked to anti-urolithiatic action. There is a noticeable antioxidant activity in both the stem and the root.

Anti-diabetic Effects:

In south Indian gardens, this insulin plant was traditionally grown as a decorative. The main component of the insulin plant that exhibits notable antidiabetic action is its leaves. In addition, it lowers postprandial blood sugar levels in the blood and further reduces fasting. Actually, it is currently unknown what exact mechanism of action underlies the primary phytoconstituents' antidiabetic effect. A number of other therapeutic effects of this plant include lowering the number of hemoglobin molecules glycosylated, controlling hepatic and renal parameters, raising weight and insulin levels, and significantly improving the histopathological examination of patients with diabetes.

Antibacterial properties:

Using 100 mg of the root of Costusigneus, Arun Nagarajan et al. (2011) investigated the plant's antibacterial properties. The research utilized gram-negative bacterial cultures, such as Pseudomonas aeruginosa, Klebsiella pneumonia, Salmonella sp., and Proteus vulgaris, to determine the antibacterial activity of Costusigneus in vitro grown root extracts. Approximately 10 grams of root materials generated from Indole 3-acetic acid (IBA) and Indole butyric acid (IAA) were subjected to Soxhlet extraction using 5 milliliters of acetone, chloroform, and methanol. For direct root induction in the study, two growth regulators—IBA and IAA in combination—were introduced to MS (Murashige and Skoog) medium. It was discovered that acetone, the solvent used to extract the aforementioned regulators from the roots of the insulin plant, was particularly effective against Klebsiella pneumonia. Its 25 mm zone of inhibition was discovered to be nearly identical to that of the antibiotic Gentamycin.

Antiurolithiatic Property:

Using an aqueous extract of the plant's stem and rhizome, Kesavan Manjula et al. (2017) investigated the antiurolithiatic properties of the insulin plant. Their findings showed that the plant extract was prepared to start the formation of hydroxyapatite (HAP) crystals and decreased the nucleation rate of CHPD crystals, a significant component of urinary calcium stones. The formation of calcium hydrogen phosphate dihydrate (CHPD) crystals has been facilitated by the exclusive diffusion gel growth approach. Additionally, research has been done on the suppressive effect of aqueous extracts derived from the leaves, stems, and rhizome of Costus igneus on CHPD crystal expansion. Five distinct concentrations of the plant extracts—0.15,0.25,0.50,0.75, and 1.00%—were chosen to assess the impact of the Costus igneus plant's aqueous extract of its leaves, stems, and rhizomes on the growth of CHPD crystals. In comparison to pure calcium chloride, the plant extract showed a repressive impact and a minimum length of developing crystals. As the aqueous extracts of Costus igneus grew in concentration from 0.15% to 1.00% (w/v), the resulting decrease in the load of the produced crystals was seen, with leaves weighing 0.06 g, rhizome weighing 0.05 g, and stem weighing 0.030 g. The inclusion of natural ingredients such as protein (18%), iron (40 mg), β-carotene, α Tocopherol, glutathione, phenols, flavonoids (diosgenin, quercetin), steroids, alkaloids and antioxidant components including water-soluble vitamin is responsible for the inhibitory effect of plant extract.

Anti-Inflammatory Potential:

Using carrageen, an induced rat model, and an in-vitro model with LPS-induced human peripheral blood mononuclear cells (hPBMCs), Kripa Krishnan (2014) investigated the anti-inflammatory potential of βamyrin isolated from the leaves of Costusigneus. At a dose of 100 mg/kg weight, the Costusigneus leaf differential fractionation methanolic extract (MEC) demonstrated a maximal percentage suppression of paw edema. Chloroform, hexane, ester, and butanol were among the solutions used in the fractionation of MEC. At a dosage of 50 mg/kg weight, the chloroform extract (CEC) of MEC demonstrated the highest beneficial result. Compared to carrageenan-induced rats, treatment with CEC markedly reduced the activities of gas synthase (NOS), myeloperoxidase (MPO), lipoxygenase (LOX), and cyclooxygenase (COX). Its isoform, β-amyrin, demonstrated a dose-dependent reduction in paw edema; at 100 µg, it generated a 97 and lessened paw edema in rats induced by carrageenan.

Effect of Learning and Memory:

Shalini Adiga et al. (2014) used a passive avoidance test at dosages of 250 and 500 mg/kg ethanolic extract to evaluate the impact of Costusigneus on learning and memory in normal and diabetic-induced rats. One intraperitoneal injection of streptozotocin (35 mg/kg) was used to induce diabetes. Rats were given a passive avoidance test and their blood sugar levels were assessed following a 30-day study period. When compared to the diabetic control group, the Costusigneus treatment dramatically lowered the blood sugar level in an extremely dose-dependent manner (75.70% reduction for 500 mg). However, with non-diabetic rats, no discernible effect was seen; instead, the values were similar to the normal control group. A few acquisition trials were conducted on rats. The amount of time it took for diabetic rats receiving Costusigneus treatment to enter the dark components decreased, indicating that the rats retained their natural behavior and improved their propensity to learn. Rats with diabetes that were not treated demonstrated deterioration in the passive avoidance test. Insulin plant extract treatment resulted in a significant increase in entry delay and a decrease in time spent in the darkroom during their post-shock retention tests at 24 and 48 hours. In summary, when given at a dose of 500 mg, the ethanolic extract of Costusigneus was able to significantly improve learning and memory in diabetic rats.

Antioxidant activity:

Using different doses ranging from 100 µg/mL to 500 µg/mL, Ramya SK et al. (2015) investigated the effect of methanol extract on antioxidant activity against Klebsiella Oxytoca, Pseudomonas Fragi, and Enterobacter aerogens. Both the stem extract and the root extract of Costusigneus were tested for their antioxidant and radical-scavenging properties. Compared to stem extract, root extract displayed a higher inhibition rate. And among the stem and root extracts of this plant, the overall phenolic levels were found to be larger in root extract. Antioxidants are also abundant in root extract. A specific hydroxyl location and structure inside the molecule allows flavonoids to donate protons and exhibit radical scavenging properties. The study clearly showed that antioxidants and polyphenols scavenge off atoms and prevent the production of free radicals.

Neuroprotective Role:

In a study conducted by Gupta D, Rai S, Hajam YA, et al. (2018), the effects of exogenous melatonin and insulin plant (Costusigneus nak) extract on the brains of female diabetic rats induced with streptozotocin were examined. The brain tissue of the rats in the extract exhibited a significant reduction in lipid peroxidation (TBARS) as compared to the control group. Additionally, the brain's levels of catalase (CAT), reduced glutathione (GSH), and SOD (SOD) significantly decreased in response to melatonin and plant extract. Further, melatonin in the form of plant extract demonstrated a noteworthy recovery to revive the cerebral complication brought on by the hyperglycemic effect of diabetes and preserved the brain tissue by bringing back the quantity of glial and astrocyte cells.

Hypolipidemic Activity:

In streptozotocin (STZ)-induced diabetic albino rats, Pazhanichamy Kalailingam et al. (2011) examined the antihyperglycemic and hypolipidemic properties of Costusigneus rhizome methanol extract (MECiR). For a duration of 30 days, rats with diabetes were administered oral doses of 100 and 200 mg/kg of MECiR once daily. The findings showed that while serum levels of high-density lipoprotein (HDL) significantly ($p<0.05$) increased in the diabetic rats, fasting glucose, total serum cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL), and very-low-density lipoprotein (VLDL) significantly ($p<0.05$) decreased. The more favorable outcome at 200 mg/kg. In diabetic albino rats generated by STZ, the antidiabetic and hypolipidemic effects were similar to those of the standard reference medication glibenclamide (5 mg/kg/b.w).

Toxicity Study:

The drug was found to be safe at the tested dose regimen of 5000 mg/kg b.wt. Administration of an ethanolic extract of C. igneus leaves at doses ranging from 50 mg/kg b.w. to 5000 mg/kg b.w. did not exhibit significant toxicity signs during the primary four hours and were followed by daily observations for 14 days. Additionally, no death rate was observed. On the other hand, results of an extensive study on the methanolic extract of C. igneus showed toxicity at 250 mg/kg weight.

PRECAUTIONS:

If you consume raw medications or leaves from the insulin plant without understanding the proper amount, it could be harmful to your health. Before using it, one should consult a medical supervisor for advise. This plant, or any part of it, should not be consumed by expectant or nursing women.

CONCLUSION

The examined publications offer insights into the potential applications of the insulin plant in the development of pharmaceutical products or as a dietary supplement to existing therapies in the future. With the numerous negative effects of oral hypoglycemic medications, there is a rising market for herbal products as alternatives to treat diabetes mellitus. The traditional medical system uses a number of plant preparations to manage diabetes mellitus. The development of herbal or semi-synthetic pharmaceutical drugs will be aided by research on novel oral hypoglycemic medications derived from medicinal plants. The insulin plant has a broad therapeutic range as well as pharmacological, biopharmaceutical, and chemical qualities based on the different chemical ingredients that are present. Each phytoconstituent's structure, structure-activity connection, and mechanism of action have been compiled. This review will aid in the development of more potent insulin plant extract formulations for a variety of conditions where it exhibits promising outcomes as an anti-diabetic treatment for diabetes mellitus, in addition to its anti-inflammatory, antioxidant, anti-proliferative, hypolipidemic, and neuroprotective properties. anti-urolithiasis, insulin plant leaves and their phytochemical constituents demonstrate the promising effect of the in silico method of study. However, it is important to remember that further research is required to determine how these substances work as dietary supplements to treat diabetes mellitus or in combination with synthetic anti-diabetic medications to improve therapeutic action and reduce side effects. It is recommended that further research be done on the unique formulation of insulin plants that uses each separated ingredient and enhances the drug's transport, bioavailability, and therapeutic impact.

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