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"A REVIEW OF A DETAILED STUDY ON THE MEDICINAL IMPORTANCE OF THE COSTUS IGNEUS PLANT"

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Abstract: Costus igneus, known as the insulin plant, is recognized for its potential medicinal properties, particularly in managing diabetes mellitus. This review evaluates its phytochemical composition, which includes flavonoids and glycosides, and examines its pharmacological effects, including hypoglycemic, antioxidant, and anti-inflammatory activities. Current research highlights the plant's ability to enhance insulin sensitivity and glucose metabolism. However, more rigorous clinical studies are needed to establish its efficacy and safety. This review emphasizes the promise of Costus igneus as a natural therapeutic agent and calls for further exploration to validate its medicinal potential.

Keywords: Costus igneus, insulin plant, hypoglycemic effects, Anti-diabetic effect, Phytoconstituents, Pharmacological activities.

Introduction

A class of metabolic diseases known as diabetes mellitus (DM) are typified by elevated blood glucose levels. Individuals with diabetes are more likely to experience a variety of serious, perhaps fatal health issues, which can lead to higher expenses for medical treatment, a lower standard of living, and a higher death rate. Chronically elevated blood glucose levels lead to widespread vascular injury that affects the kidneys, heart, eyes, and nerves and can result in a number of problems. [1]Since 2000, the International Diabetes Federation (IDF) has generated estimates of the prevalence of diabetes Previous estimates of the prevalence of diabetes have demonstrated a large and increasing burden, with significant regional variability. The estimates in this paper provide the latest figures based on the most recent and highest quality data on diabetes prevalence for 219 countries and territories. [2]

Costus Igneus belongs to the family Costaceae, commonly known as insulin plant in India because its leaves help to build up insulin in the human body The need for herbal treatments for the management of diabetes mellitus is rising because oral hypoglycemic medications have a number of negative effects. Traditional medicine and folklore both employ a variety of plant concoctions to treat diabetes mellitus. Future research on novel oral hypoglycemic chemicals derived from medicinal plants will pave the way for their use as dietary supplements to current treatments or as a step toward the creation of pharmaceutical entities. One such traditional plant that is currently gaining popularity worldwide and being utilized extensively as an ayurvedic medicinal herb is the insulin plant. It is thought that eating the leaves will decrease. [3] The popular names Fiery Costus and Spiral Flag in Sanskrit refer to the Costaceae family, which contains the Costus igneus and is found in tropical Africa, Asia, and Australia. It's located in India. grown in coastal areas, like the Uttar Kannada section of the state of Karnataka. Locals in this area usually take two to three leaves of this plant twice a day to manage diabetes. This plant extract demonstrated the presence of carbohydrates, proteins, steroids, alkaloids, tannins, glycosides, saponins, fixed oils, and flavonoids by preliminary phytochemical screening. Research has demonstrated that plant flavonoids have antioxidant properties. [4]

Morphology

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. Being a rhizomatous shrub, the plant pierces the earth by its underground tuberous rhizome. 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. Costus is primarily found in the regions of South India and Kashmir in India.

FIG. 1: INSULIN PLANT

FIG. 2: STEM OF *COSTUS IGNEUS* PLANT

FIG. 3: LEAF OF *COSTUS IGNEUS* PLANT

FIG. 4: RHIZOMES OF *COSTUS IGNEUS* PLANT

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 frequently be a threat, particularly in light sandy soil. There are no illnesses that significantly hinder plant growth at the moment. [5]

Vernacular Names [5]

Sr.No	Language	Names
1.	Gujarati	Pakarmul
2.	English	Spiral Ginger, Spotted Spiral Ginger, Painted Spiral Ginger
3.	Telugu	Peddavesiga, Yeangesha
4.	Urdu	Bijasar, Dam alakhwain
5.	Bengali	Piasal
6.	Hindi	Banda, Bija-sal, Peisar, JARUL, Keukand
7.	Marathi	Honi, Pushkarmula

Taxonomy [6]

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

Phytoconstituents

Plant components containing flavonoids, alkaloids, and terpenoids are rich in phytochemicals. This herb was originally used to treat diabetes in rats used in experiments in India. Plant sections that include bio-components include leaves, stems, rhizomes, and roots. [7]

a) Leaves: Compared to other solvents, the methanolic extract of the Costus igneus plant's leaves revealed the highest concentration of compounds (secondary metabolites), including steroids, phenols, triterpenoids, alkaloids, tannins, flavonoids, glycosides, saponins, carbohydrates, and proteins.Sequential antioxidant screening of Costus leaves for phytochemicals revealed that the leaves are rich in iron, protein, and other components such α tocopherol, β carotene, terpenoids, steroids, flavonoids, and diosgenin.[8]

b) Stem:demonstrated the presence of the steroid component stigmasterol and the terpenoid molecule lupeol.[9]

c) Rhizome: The rhizome of Costus igneus yielded the bioactive components quercetin and diosgenin, a steroidal sapogenin. [10]

d) Root: Tannins, Alkaloids, Terpenoids, etc. [11]

Phytochemicals of essential oils:

Plant Parts	Essential Oils
Leaf	Hexadecanoic acid, 2-pentanol, Dodecanoic acid, β-ionone, Famesyl acetone, A-ionone
Stem	Hexadecanoic acid, 9,12-octadecadienoic acid, Dodecanoic acid,Linalyl propanoate, Tetradecanoic acid, A-eudesmol, γ-eudesmol 4-ethaoxy phenol
Rizome	Hexadecanoic acid, 9,12-octadecadienoic acid, Dodecanoic acid, Tetraadecanoic acid, Linalool, α –tetrpineol

Benefits

Blood sugar regulation: The ability of the insulin plant to control blood sugar levels has long been recognized. It is thought to increase insulin sensitivity and boost insulin production, which makes it advantageous for those who have diabetes.

Digestive health: Eating the leaves of the insulin plant may help with bowel motions, reduce discomfort in the stomach, and facilitate digestion. It is frequently used to treat digestive issues like indigestion and constipation.

Effects against inflammation: The insulin plant has anti-inflammatory qualities that may aid in the body's reduction of inflammation. It may be helpful in treating diseases like inflammatory bowel disease and arthritis because of this characteristic.

Immune system support: The high vitamin C concentration of insulin plant leaves may help to fortify the immune system when consumed on a regular basis. It strengthens the body's defenses against diseases and infections.[12]

Pharmacological Activities

Numerous activities related to the insulin factory have been documented.Several of them have have not yet been proven. Leaf, stem, root, rhizome, and entire plant are among the plant parts that exhibit these kinds of behaviors. A notable hypoglycemic potential is attributed to leaves. The main reported activity of the stem is antiurolithiatic. There has been evidence of strong antioxidant activity in both the stem and the root.

Anti-diabetic Effect: Glycemic control in diabetics was successfully achieved in a cross-sectional clinical research by patients who consumed one fresh leaf or one teaspoon of shade-dried powder of costus igneus per day in addition to other forms of treatment. This plant also has other therapeutic advantages, such as lowering difficulties associated with diabetes, stabilizing hepatic and renal parameters, lowering levels of glycosylated hemoglobin, increasing weight and insulin levels, and showing significant improvements in the histopathological examinations of diabetic patients. [13]

Anti-Inflammatory Effect: In-vitro paradigm aasnd carrageen, an induced rat model, to investigate the anti-inflammatory potential of β-amyrin isolated from Costusigneus leaves. At a dosage of 100 mg/kg weight, the Costusigneus leaf methanolic extract (MEC) showed the highest percentage of 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 rats given carrageenan, treatment with CEC significantly reduced the activities of gas synthase (NOS), myeloperoxidase (MPO), lipoxygenase (LOX), cyclooxygenase (COX), and lipoxygenase (LOX). Its isolated β-amyrin demonstrated a dose-dependent reduction in paw edema, and it decreased the amount of carrageenan-induced paw edema in rats and generated a 97 at a dose of 100 μg. [14]

Anti-proliferative Effect: Investigated the effects of a methanolic extract of powdered leaves from Costus igneus (MECiL) on the in vitro MCF 7 (Michigan Cancer Foundation-7) breast cancer cell line, looking at both the anti- proliferative and apoptotic properties. Without harming the normal cells, the extract (MECiL) was able to shrink the tumor. Viability of cells and cytotoxicity of the extract (15–2000 μg/ml) were also assessed using the MTT (3– (4, 5-dimethyl thiazol-2–yl)–2, 5 diphenyl tetrazolium bromide assay test) on L6 Rat Skeletal Muscle Cell Line. The IC- 50 value of the insulin plant leaves extract in this study was 2000 μg/ml. Only at very high concentrations did the extract exhibit cytotoxicity consistent with conventional cell lines; it was not apoptotic. The extract demonstrated strong anticancer properties at the highest dosage of 2000 μg/ml. [3]

Anti-cancerous Activity: One of the biggest health issues that both developed and developing nations in the world are dealing with is cancer. Within the most prevalent cancer types (breast, stomach, colorectal, liver, and lung), breast cancer is the most frequently diagnosed cancer in women, while lung cancer is the most frequently diagnosed cancer in males. There were millions of cancer survivors globally (within five years of diagnosis), 14.1 million new cases, 8.2 million cancer deaths, and 32.6 million new cases of the major forms of cancer in 184 countries in 2012, according to estimates from the International Agency for Research on Cancer. According to estimates, there would be 26 million new instances of cancer and 17 million annual cancer deaths by 2030. investigated the safety of a methanolic extract of Costus igneus for normal human cells, as well as its anti-proliferative and apoptotic qualities, in vitro.Because Costus igneus contains significant amounts of phytochemicals such alkaloids, glycosides, terpenoids and steroids, flavonoids, reducing sugars, triterpenes, phenolic compounds, tannins, and saponins, the results showed that (MECiL) reduces tumour size without harming normal cells. concentrated their research on finding the diosgenin in the rhizome of Costus igneus that possesses the anticancer ability to successfully block STAT3 activation. Molecular docking experiments for STAT3 with diosgenin are more interactive and bind firmly at the active site, according to results from docking diosgenin against target proteins STAT3, JAK, and IL-6 using AutoDock 4.2. These outcomes support the use of Costus igneus vegetation. [4]

Antiurolithiatic Property: Examined the antiurolithiatic activity using the Costus igneus plant's aqueous extract of the stem and rhizome. The plant extract, which is a crucial component of urinary calcium stones, was found to increase the development of hydroxylapatite (HAP) crystals and inhibit the growth of CHPD crystals. The single diffusion gel growth method was used to generate crystals of calcium hydrogen phosphate dihydrate (CHPD). The effect of the Costus igneus plant's aqueous sex tracts on the formation of CHPD crystals was later discovered in the leaves, stem, and rhizome. Here, five distinct concentrations of these plant extracts—0.15,0.25,0.50,0.75, and 1.0 percent—were chosen. When compared to the control (pure calcium chloride), the plant extracts had an inhibitory impact with minimum apparent crystal length.The weight of the produced crystals gradually decreased from 2.03g to 0.03g (stem), 0.05g (rhizome), and 0.06g leaves when the concentration of Costus igneus' aqueous extract was increased from 0.15% (w/v) to 1.00% (w/v).[16]

Neuroprotective Role: Examined the effects of exogenous melatonin and insulin plant (Costus igneus nak.) extract on the brain's neuroprotective properties in diabetes-induced female rats with streptozotocin. Lipid peroxidation (TBARS) in brain tissue was significantly reduced by the extract when compared to the rats in the control group. Moreover, melatonin and plant extract significantly decreased the brain's levels of the antioxidant enzymes catalase (CAT), reduced glutathione (GSH), and superoxide dismutase (SOD). Melatonin and plant extract both demonstrated a strong ability to repair brain complications brought on by the hyperglycemic effect of diabetes and preserved brain tissue by increasing the quantity of glial and astrocyte cells. [17]

Hypolipidemic Activity: Examined the hypolipidemic and antihyperglycemic properties of Costus igneus rhizome methanol extract (MECiR) in diabetic albino rats were induced with streptozotocin (STZ). For a duration of 30 days, MECiR was administered orally to rats with diabetes at doses of 100 and 200 mg/kg as a single dose each day. The results showed that in the diabetic rats, serum levels of high-density lipoprotein (HDL) increased significantly ($p<0.05$) while those of fasting blood glucose, serum total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) decreased significantly ($p<0.05$). A superior outcome was achieved using 200 mg/kg. In diabetic albino rats generated by STZ, the antidiabetic and hypolipidemic effects were similar to those of the usual reference medication, glibenclamide (5 mg/kg/bw).[18]

Antimicrobial Activity: With respect to gram-positive strains of Bacillus cerus, Bacillus megaterium, Micrococcus leuteus, Staphylococcus aureus, and Streptococcus lactis, as well as gram-negative strains of Pseudomonas aeruginosa, Escherichia coli, Enterobacter aerogenes, Klebsiella pneumoniae, and Salmonella typhimurium, the methanolic extract of C. igneus demonstrated the strongest antibacterial activity. The component that was separated from the ethanolic extract of Costus igneus exhibited a moderate level of antibacterial and antifungal activity against Candida albicans, Eschericia coli, and Staphylococcus aureus. [19]

Toxicity study: The drug was found to be safe at the tested dose level of 5000 mg/kg b.wt. Administration of an ethanolic extract of C. igneus leaves, ranging from 50 mg/kg b.w. to 5000 mg/kg b.w., did not show any significant toxicity signs during the first four hours and was observed daily for 14 days. Additionally, no mortality was noted.However, results from a study on C. igneus's methanolic extract showed toxicity at 250 mg/kg body weight. [20]

The impact of Costus igneus on learning and memory: The passive avoidance test was used to compare the effects of 250 and 500 mg/kg ethanolic extract of Costus igneus on learning and memory in rats with normal and diabetic conditions. A single injection of streptozotocin (35 mg/kg) intraperitoneally resulted in diabetic. Following the 30-day trial period, the rats were put through a passive avoidance test and the blood glucose level was measured. In diabetic individuals, treatment with Costus igneus significantly lowered blood glucose levels in a dose-dependent manner (reduction of 75.70 percent for 500 mg) as compared to the diabetic control group. Rats without diabetes, whose normal readings were the same, did not, however, exhibit any discernible reaction. There were three acquisition experiments conducted on the rats. Costus igneus-treated diabetic rats showed improved learning propensity and preserved innate behavior, as evidenced by their reduced time to enter the dark compartment compared to the untreated diabetic rats. demonstrated a decline in the test of passive avoidance. In addition, the application of Costus igneus extract resulted in a noteworthy rise in movement towards the entrance and a reduction in the amount of time spent in the darkroom throughout the 24- and 48-hour post-shock retention experiment. The thanolic extract of the Costus igneus plant therefore successfully enhances the memory and learning of diabetic rats. [21]

Antioxidant Property: Alkaloids, flavonoids, sugars, glycosides, saponins, tannins, phytosterols, and phenolics are among the phytochemicals that these three extracts are good sources of, according to bioactive screening. The FRAP, superoxide radical, and DPPH scavenging activities of the C. igneus acetone extract were greater in in vitro antioxidant experiments. The hexane extract of C. igneus recorded considerable maximal reducing power with the highest optical density, and it showed the highest potential in ABTS scavenging activity and antioxidant capacity in the phosphomolybdenum assay. In the meantime, the best metal ion-chelating capacity was shown by the hot water extract. When C. igneus acetone extract was compared to doxorubicin, a positive control, it showed the maximum cytotoxic activity against the cancer cell line (MCF-7). Therefore, our work emphasizes C. igneus's significant cytotoxic potential and excellent antioxidant activity, pointing to the possibility of safe and affordable biological applications for the plant. [22]

Hepatoprotective Activity: Examined the Costus igneus plant's hepatoprotective properties against rats hepatic damage caused by paracetamol. In this experiment, liver damage was caused by oral paracetamol at a dose of 300 mg/kg. The alcoholic extract of Costus igneus leaves was utilized, along with 100 mg/kg of ardina and the medication Silymarin as benchmarks. Elevated serum enzyme levels demonstrated liver injury, which was further supported by a histological image displaying zonal focal necrosis. The induction of damage by paracetamol was effectively averted by administering extracts from Costus igneus before the drug was administered ($P<0.05$). Normal enzyme levels and the lack of necrotic alterations in the pathological investigations served as confirmation. [23]

Hypoglycemic Activity: Purified from the costus igneus, ILP (insulin-like protein) is a novel protein having hypoglycemic activity. The hypoglycemic effect of the ILP lasted for almost an hour after application, suggesting that it has good therapeutic potential. In an in vitro investigation, the insulin-like protein (ILP) showed hypoglycemic effect using the insulin-responsive cell line RIN 5f. It's interesting to note that ILP significantly decreased glucose levels when taken orally during an oral glucose tolerance test. [24]

Antibacterial activity: Using an inoculating loop, the organism colonies from standard cultures of Staphylococcus aureus ATCC 6538 and Escherichia coli ATCC 25922 that were developed overnight were collected. suspended in sterile saline (3–4.0 mL). This was employed as the assay's inoculum and was later adjusted to 0.5 McFarland's standard. A sterile petri plate was filled with 1.0 mL of the bacterial inoculum along with sterile Muller nutritional agar. After being poured over the level surface, the petri plates were left to harden. Using sterile cork drills, each measuring 8 mm in diameter, four wells were punched in. The wells were then filled with 100 µl of each dilution of the cold and hot plant extracts. For 24 hours, plates were incubated at 37º C. [25]

Marketed Products:

PRODUCT NAME	CATEGORY	MANUFACTURER
Insulin Plant Leaf powder 180g	Dietary supplement	TheInsulinPlant.com, USA
Kostam Keerai (*Costus igneus*) Capsule 500mg	-	Agroline Mori tantraa
Diabestop 500mg Capsule	Food supplement	Herbs & Nutri Pharma

Glucobeet plus Capsule 500mg	Blood sugar supportive Supple ment	Orange organic pharma
Daun Insulin	20 Herbal tea bags	Tigadaun

Conclusion:

This review highlights the medicinal significance of Costus igneus, particularly its antidiabetic, anti-inflammatory, and antimicrobial properties. Traditional uses are supported by scientific evidence, demonstrating its potential as a therapeutic agent. While current findings are promising, further clinical trials are necessary to establish its efficacy and safety. Overall, Costus igneus represents a valuable resource for natural medicine, warranting more in-depth research to fully realize its therapeutic applications.

Reference:

1. Cho, N. H., Shaw, J. E., Karuranga, S., Huang, Y., da Rocha Fernandes, J. D., Ohlrogge, A. W., & Malanda, B. I. D. F. (2018). IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes research and clinical practice, 138, 271-281.
2. Guariguata, L., Whiting, D. R., Hambleton, I., Beagley, J., Linnenkamp, U., & Shaw, J. E. (2014). Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes research and clinical practice, 103(2), 137-149.
3. Mathew, F., & Varghese, B. (2019). A review on medicinal exploration of Costus igneus: the insulin plant. Int J Pharm Sci Rev Res, 54(2), 51-57.
4. Arivu, I., Muthulingam, M., & Selvakumar, G. DETAILED STUDY ON COSTUS IGNEUS PLANT FOR ITS MEDICINAL IMPORTANCE-A REVIEW.
5. Athilli, L., Siddiqui, A. F., Hussain, F., & Parvez, E. A. H. (2021). Pharmacognostic Study And Pharmacological Potentials Of Costus Igneus Plant–Review. IJP, 8(12), 476-486.
6. Darade, R. R., & Dhamane, P. S. (2024). A REVIEW ON COSTUS IGNEUS OR INSULIN PLANT.
7. Hegde, P. K., Rao, H. A., & Rao, P. N. (2014). A review on Insulin plant (Costus igneus Nak). Pharmacognosy reviews, 8(15), 67.
8. Shinde, S., Surwade, S., & Sharma, R. (2022). COSTUS IGNEUS: INSULIN PLANT AND IT'S PREPARATIONS AS REMEDIAL APPROACH FOR DIABETES MELLITUS. International Journal of Pharmaceutical Sciences and Research, 13, 1551-1558.
9. Datta, S. K., Maity, S., & Konar, S. Exploring the Anti-Diabetic Potential: A Comparative Review of Phytoconstituents from Costus igneus and Gymnema sylvestre with Structure-Activity Correlation Analysis.
10. Manjula, K., Pazhanichamy, K., Kumaran, S., Eevera, T., Dale Keefe, C., & Rajendran, K. (2012). Growth characterization of calcium oxalate monohydrate crystals influenced by Costus igneus aqueous stem extract. Int J Pharm Pharm Sci, 4(Suppl 1), 261-70.
11. Kalailingam, P., Sekar, A. D., Samuel, J. S. C., Gandhirajan, P., Govindaraju, Y., Kesavan, M., ... & Tamilmani, E. (2011). The efficacy of Costus igneus rhizome on carbohydrate metabolic, hepatoproductive and antioxidative enzymes in streptozotocin-induced diabetic rats. Journal of Health Science, 57(1), 37-46.
12. Pazhanichamy, K., Pavithra, S., Rubini, S., Lavanya, B., Ramya, I., & Eevera, T. (2010). Morphological, anatomical and proximate analysis of leaf, root, rhizome of Costus igneus. Journal of pharmacy Research, 3(4), 747-752.
13. Ugaoo. (n.d.).Unveiling the marvelous insulin plant: Care, benefits, and varieties.Retrieved October 18, 2024, from https://www.ugaoo.com/blogs/gardening-basics/unveiling-the-marvelous-insulin-plant-care-benefits-and-varieties.
14. Bhoye, h. Y., & gaikwad, m. Y. (2024).*Costus igneus plant: with their therapeutical values other than anti-diabetic effect.* Int. J. Of pharm. Sci., 2024, vol 2, issue 4, 553-562.
15. Soni, v. S. T., & shrivastava, m. Biological activities of insulin plant: costus igneus. Recent trends in, 29.
16. Yuvarani, T. H. A. N. I. K. A. S. A. L. A. M., Manjula, K. E. S. A. V. A. N., & Ananda, G. P. (2017). Growth and characterization of calcium hydrogen phosphate Dihydrate crystals influenced by Costus igneus aqueous extract. Int J Pharm Pharm Sci, 9(5), 173-8.
17. Gupta, D., Rai, S., Hajam, Y. A., Ghosh, H., & Basheer, M. (2018). Neuroprotective Role of Exogenous Melatonin and Insulin Plant (Costus igneus nak.) Extract on Brain in Streptozotocin-Induced Diabetes in Female Rat. Research & Reviews: A Journal of Pharmacognosy, 5, 33-41.

18. Kalailingam, P., Kaliaperumal, R., Shanmugam, K., & Tamilmani, E. (2011, February). Efficacy of Methanolic Extract of Costus igneus rhizome on hypoglycemic, hypolipidimic activity in streptozotocin (STZ) diabetic rats and HPTLC analysis of its active constituents. In International Conference on Bioscience, Biochemistry and Bioinformatics (Vol. 5, pp. 318-321).
19. Ayyanar, M., & Ignacimuthu, S. (2005). Traditional knowledge of kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu, India. Journal of ethnopharmacology, 102(2), 246-255.
20. Bhat Vishnu, B. V., Asuti Naveen, A. N., Kamat Akshay, K. A., Sikarwar, M. S., & Patil, M. B. (2010). Antidiabetic activity of insulin plant (Costus igneus) leaf extract in diabetic rats.
21. Radha, A., Balasubramanian, K., Shruti, B. S., & Nandhini, S. R. (2015). Studies on Optimization of Medium in Induction and Regeneration of Callus and Shoot from Costus igneus and its Phytochemical Profile. Journal of Academia and Industrial Research (JAIR), 4(2), 75.
22. Vishalakshi Devi, D., & Urooj, A. (2010). Nutrient profile and antioxidant components of Costus speciosus Sm. And Costus igneus Nak. Indian Journal of Natural Products and Resources, 1(1), 116-118.
23. Chacko, N., & Shastry, C. S. (2012). Hepatoprotective activity of Costus igneus against Paracetamol induced liver damage. International Journal of Advances in Pharmacy, Biology and Chemistry, 1(2), 247-251.
24. Joshi, B. N., Munot, H., Hardikar, M., & Kulkarni, A. A. (2013). Orally active hypoglycemic protein from Costus igneus NE Br.: an in vitro and in vivo study. Biochemical and biophysical research communications, 436(2), 278-282.
25. Patil, S., & Ahuja, M. (2019). Phytochemical Analysis and Antibacterial Determination of Costus Igneus Leaves.