Abstract

Costus igneus is an important medicinal plant reported in Ayurveda. It is also known as Spiral flag, fiery costus or Insulin plant, a member of family Costaceae. It is native to Eastern Brazil and widely grown in South India and certain parts of Kashmir and Himalaya as well. The various extracts of plant have been reported to possess number of pharmacological activities such as antidiabetic, hypolipidemic, anti-inflammatory, antimicrobial, antioxidant, hepatoprotective, anti-proliferative and many more. Individual phytoconstituents such as quercetin, diosgenin, beta-carotene, flavonoids, steroids, terpenoids, phenol, and alkaloids have been reported for their presence in various parts of plant and efficacy as well. The present review will provide updated compiled information about plant regarding its occurrence, phytochemistry and reported biological activities which can be helpful for the researchers working on this plant.

1. INTRODUCTION

Number of plants has been utilized for treatment of various diseases since many years. Costus igneus is a herbaceous plant (Costaceae) specially used in South India to treat Diabetes and also considered as an ornamental plant in various parts of the world (Urmila Choudhary et al, 2014; N.D. Satyanarayan, 2015). It is a nature’s gift for the people who are suffering from diabetes (Choudhary Urmila et al, 2015). In an Indian Ayurvedic system, diabetic patients are advised to chew leaves of Costus igneus for a month two
times (in morning first leaf before breakfast and in evening) before swallowing to control blood glucose level. *Costus igneus* is also mentioned in Allopathic and Siddha system of medicine for its therapeutic potential such as to promote longevity, treats skin rash, fever, asthma, bronchitis, and to eliminates intestinal worms (Palanivel V et al, 2013).

1. Occurrence, Botanical Description and Ethno pharmacology

![Figure 1: Leaves and Flowers of Costus igneus](a) (b) (c)

2. OCCURRENCE, BOTANICAL DESCRIPTION & ETHNOPHARMACOLOGY

2.1 Occurrence: *Costus igneus* is mainly found in the regions of Kashmir and South India. It is known by different vernacular names (Hindi)–keukand, (Marathi)–Honi, Pushkarmula, (Gujarati)–Pakarmula (Tamil)–Kostam, (Sanskrit)–Asana (Vishalakshi Devi et al., 2010).

2.2 Botanical description: -

- **Leaf**: The (c) large, smooth, simple type, alternate arranged, oblong shaped, (a) green colour leaves have light purple undersides (b) and are spirally arranged around stems, forming attractive, arching clumps arising from underground rootstocks.

- **Flower**: The plant flowers are of beautiful orange colour (c), are produced in the warm months. Flower petals are quite sweet and nutritious. The plant also bears fruit, but its shape is unknown.

- **Plant**: It reaches to about two feet tall, with the tallest stems falling over and lying on the ground. Plant grows in partially shade/ partially sun and it requires occasionally wet, slightly alkaline, clay, sand. *Costus* does not have problem with pests and disease (Satyanarayan et al, 2015).

2.3 Ethanopharmacology: In Ayurvedic system of medicine patients suffering from diabetes have been advised to chew the plant leaves consistency for 30 days twice a day to maintain blood glucose level. Root of *Costus igneus* has used as powder, decoction and oil (Arun Nagarajan et al, 2011).
### 3. PHYTOCHEMISTRY

<table>
<thead>
<tr>
<th>Compound</th>
<th>Molecular Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascorbic acid</td>
<td><img src="image" alt="Ascorbic acid" /></td>
</tr>
<tr>
<td>Quercetin</td>
<td><img src="image" alt="Quercetin" /></td>
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<tr>
<td>Lupeol</td>
<td><img src="image" alt="Lupeol" /></td>
</tr>
<tr>
<td>Stigmasterol</td>
<td><img src="image" alt="Stigmasterol" /></td>
</tr>
<tr>
<td>Corosolic acid (2α-Hydroxyursolic acid)</td>
<td><img src="image" alt="Corosolic" /></td>
</tr>
<tr>
<td>Gracillin</td>
<td><img src="image" alt="Gracillin" /></td>
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<tr>
<td>Glycyrrhetinic acid</td>
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</tr>
<tr>
<td>Epicatechin</td>
<td><img src="image" alt="Epicatechin" /></td>
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<tr>
<td>Chemical</td>
<td>Molecular Structure</td>
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<tr>
<td>Sitosterol</td>
<td><img src="image1" alt="Sitosterol" /></td>
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<tr>
<td>Tigogenin</td>
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<tr>
<td>Squalene</td>
<td><img src="image3" alt="Squalene" /></td>
</tr>
<tr>
<td>Cinchonain Ib</td>
<td><img src="image4" alt="Cinchonain Ib" /></td>
</tr>
<tr>
<td>Beta-pyrazol-1-ylalanine</td>
<td><img src="image5" alt="Beta-pyrazol-1-ylalanine" /></td>
</tr>
<tr>
<td>Hexadecanoic acid</td>
<td><img src="image6" alt="Hexadecanoic acid" /></td>
</tr>
<tr>
<td>9,12 Octadecadienoic acid</td>
<td><img src="image7" alt="9,12 Octadecadienoic acid" /></td>
</tr>
<tr>
<td>Tetradecanoic acid</td>
<td><img src="image8" alt="Tetradecanoic acid" /></td>
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</tbody>
</table>
Number of phytoconstituents present in *Costus igneus* have been reported such as ascorbic acid, α-tocopherol, β-carotene, terpenoids, steroids, and flavonoids which are responsible for its anti-oxidant potential (Khan et al, 2014). Antioxidants from plant are reported to have antitumor activity as well (R. Sarawathi et al, 2010). Methanolic extract of this plant reported to have major portion of Carbohydrates, proteins, alkaloids, tannins, saponins. Analysis of successive extracts showed presence of steroids in all extracts. Ethanolic extract of stem showed the presence of a terpenoid compound lupeol and a steroid compound stigmasterol. Bioactive compounds quercetin and diosgenin, a steroidal sapogenin, were isolated from ethanolic extract of *C. igneus* rhizome (Rao et al, 2014).

Successive extraction of *C. igneus* stem extract contains flavonoids, tannins and their roots contain terpenoids, alkaloids, and tannins and have been reported to treat various diseases. The rhizome part of *C. igneus* contains higher amount of tannins, phlobatannins, saponins, flavonoids, steroids, terpenoids, and cardiac glycosides. The seeds of this plant reported to contain Dioscin, protodioscin, methyl protodioscin, gracillin, custusoside, B-sitostero (R. Saraswathi et al, 2010).

Reports also showed that leaves of *C. igneus* contain Tigogenin, gracillin, sitosterol, D-glocoside. Composition of essential oil was identified by GC-MS in stems, leaves and rhizomes of *Costus igneus*. The major constituents identified in the leaves of plant were hexadecanoic acid (19.53%), 9, 12-octadecadienoic acid, ethyl ester (6.58%), tetradecanoic acid (5.22%), ethyl oleate, oleic acid, and squalene. Hexadecanoic acid was present as a major constituent in all three essential oil.

Number of constituents like roseoside, epigallocatechingalllate, beta-pyrazol-1-ylalanine, cinchonainlb, leucocyandin-3-O-beta-d-galactosyl, cellobioside, leucopelargonidin-3-O-alpha-L-rhamnoside, glycyrrhetic acid, dehydrotrametenolic acid, strictinin, isostictinin, pedunculagin, epicatechin, christinin-A have been isolated (Rao et al, 2014) and reported to possess significant insulin mimetic activity along with significant antidiabetic activity. Corosolic acid which is also known as 2α-Hydroxyursolic acid/glucosol, is a pentacyclic triterpine, reported for its presence and potent antidiabetic activity in *Costus igneus* as well as in many others plants. There are few reports which showed presence of corosolic acid in low concentration and act as an antidiabetic by enhancing glucose metabolism.

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**Table 1: Chemical constituents of Costus igneus**

<table>
<thead>
<tr>
<th>Chemical Constituents</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dioscin</td>
<td><img src="image" alt="Dioscin Molecule" /></td>
</tr>
</tbody>
</table>

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4. BIOACTIVITY

*Costus igneus* has been widely reported for its various therapeutic potential such as antidiabetic, hypolipidemic, anti-cancer, diuretic, antioxidant, ameliorative, anti-microbial etc (Rao et al, 2014).

4.1 Antidiabetic

There are many reports discussing about antidiabetic effect of insulin plant. Following table summarizes compiled studies conducted by various groups of researcher.

**Alloxan induced model**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Journal, Author, Year</th>
<th>Animal, body weight</th>
<th>Route of administration for extract</th>
<th>Extract</th>
<th>Conclusion</th>
</tr>
</thead>
</table>

**Streptozotocin induced model**

<table>
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<tr>
<th>S. No.</th>
<th>Journal, Author, Year</th>
<th>Animal, body weight</th>
<th>Route of administration for extract</th>
<th>Extract</th>
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</table>

4.2 Hypolipidemic
Alcoholic extract of *C. igneus* plant at the dose of 100, 200, 400 mg/kg (p.o.) was found to significantly decreased the level of serum cholesterol, triglycerides, low density lipid in Triton-induced hyperlipidemic rats. Atorvastatin was used as a standard. Authors concluded that extract has potential to increase high density lipid and decrease low density lipid level (Chacko N et al, 2012).

4.3 Antimicrobial
Silver nanoparticles of leaf extract were found to have enhanced antimicrobial activity, and antifungal (Sharanappa T Nandibewoor et al, 2012). Agar well diffusion method was used to test the antibacterial potential of *C. igneus* methanolic extract (100 mg/ml) which showed maximum zone of inhibition (7mm) against E. coli species (Vasantharaj et al, 2013). *In vitro* evaluation of antifungal activity of *Costus* (*C. specious, C. igneus* and *C. pictus*) has been reported. Among the 3 species *C. pictus* showed slightly higher antifungal

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<th>Route of Administration for extract</th>
<th>Extract</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>International Journal Of Ayurveda Research Shetty J. Akhila, Chodhary Divya, 2010</td>
<td><em>Albino wistar rats</em>, 150-200gms</td>
<td>Oral</td>
<td>Leaf powder 100, 250 and 500mg/kg</td>
<td>Leaves has potential to bring down the fasting sugar level.</td>
</tr>
</tbody>
</table>
activity followed by *C. specious* and *C. igneus* by employing various concentrations of methanolic rhizome extract (Sulakshana et al, 2015).

**4.4 Anti-inflammatory**

The β-amyrin a triterpenoid present in *Costus igneus* has been reported for potent anti-inflammatory activity by preventing the prostaglandin-E2(PGE2), cyclo oxygenase-2(COX-2), and interleukin-6(IL-6) via the inhibition of translocation of NF-κB from the cytoplasm to the nucleus during Lipopolysaccharide-induced inflammation (K. Krishnan et al, 2014).

**4.5 Antioxidant**

Ethanolic extract of *C. igneus* rhizome at 200mg/kg was orally administered to diabetic rats for 30 days showed a significant antioxidant effect (Kalailingam et al, 2011). Antioxidant potential of ethanolic extract of leaves was found significantly effective by reducing glutathione and super oxide dismutase (Shivaprakash et al, 2014).

**4.6 Anti-proliferative effect**

An *in vitro* study was carried out on MC-F-7 Breast cancer cell line to evaluate the anti-proliferative and apoptotic effect of methanolic extract of *Costus igneus* leaves. Authors have concluded that extract showed potent cytotoxicity against the MCF-7 cell line by reducing tumor cell size (S. Dhanasekaran, 2014).

**4.7 Hepatoprotective**

In this protocol authors found that *Costus igneus* ethanolic leaves extract had sufficient potential to prevent the damage induced by paracetamol in liver when compared to standard silymarin and it was confirmed by histopathological studies as well (Chacko et al, 2012).

**4.8 Ameliorative effect**

In another study ethanolic extract of rhizomes of *C. igneus* used to evaluate the ameliorative effect on mitochondrial enzymes in alcohol induced free radical toxicity in male albino rats. According to result mitochondrial enzymes were restored to normal levels after 21 days.

**4.9 Cognitive dysfunction**

Diabetic patients are reported for having cognitive dysfunction due to changes in glucose utilization and oxidative stress. Authors have concluded that alcoholic leaves extract of *C. igneus* was found to be effective which was analyzed by passive avoidance test (Adiga et al, 2014).

**4.10 Hepatoprotective**

Ethanolic extract from rhizome of *Costus igneus* at a single dose of 100 and 200 mg/kg per day orally administered to diabetes induced rats for 30 days. Carbohydrate metabolic enzymes such as glucokinase-6-phosphatase, hepatoprotective enzymes such as aspartate and antioxidative enzymes such as superoxide dismutase, catalase, glutathione peroxidase in liver, kidney and pancreas activity were investigated in this study *Costus igneus* was found to reverse the oxidative stress in liver, pancreas (Kalailingam P et al, 2010).
4.11 Urinary stones influenced by *Costus igneus*.
In this study authors have used aqueous extract of leaves, rhizomes, stems of *C. igneus* and they found extract was capable to promote the formation of Calcium oxalate dehydrate (COD) crystals and reduce the nucleation rate of Calcium oxalate monohydrate (COM) crystals (M. Kesavan et al, 2012).

4.12 Antilithiatic
Lithiasis is the disease of urinary system where urinary calculus is formed in the kidney and urinary tract. Numerous medicinal plants have been reported for the management of renal stone so far. Aqueous and ethanolic extract of *Costus igneus* (stem) were found significant in decreasing the calcium and oxalate level (Tushar et al, 2014).

5. CLINICAL STUDY
A study was conducted in diabetic patients to check blood glucose level who have been consuming insulin plant leaves. Researchers found significant reduction in glucose level and there was no adverse effect due to consumption of this plant (Shetty et al, 2010).

6. TOXICITY STUDY
Administration of ethanolic extract of *C. igneus* leaves from 50-5000 mg/kg did not show significant toxicity sign by daily observations for 14 days. At the tested dose level of 5000 mg/kg the drug was found to be safe. Whereas, methanolic extract showed toxicity at 250 mg/kg dose (Vishnu Bhat et al, 2010; K. Krishnan et al, 2014).

7. QUALITY CONTROL
Quantitative estimation of lupeol and stigmasterol in *Costus igneus* by high performance thin liquid chromatography (HPTLC):- Authors have performed HPTLC study of lupeol and stigmasterol by using ehanolic extract (stem) of *Costus igneus*. *n*-Hexane: *Ethyl acetate* for lupeol and *Toluene: aceticacid: acetone* for stigmasterol used as a mobile phase, and further identified by IR and NMR and these two compounds could detect at monogram (K. Manjula et al, 2013).
In another study authors have performed the column chromatography to identified the active phytoconstituents and purified by high performance liquid chromatography. Authors concluded that crude leaves extract has hypoglycemic effect on the L6 cells (Swarnalath. Y et al, 2015).
In another study quantitative estimation of diosgenin present in leaves and rhizomes were performed using High performance liquid chromatography in different species of *Costus* (*igneus, pictus, speciosus*). Authors have concluded that not only in 3 different species even different part of same species has different concentration of diosgenin. Rhizomes has higher amount of diosgenin in comparision with leaves of *C. Pictus* (G. Sulakshana et al, 2014).
In another research, authors have performed gas chromatography-mass spectrometry which revealed that 20 phytochemicals like alkaloids, terpenoids are present in methanolic extract of leaves (Vasantharaj et al, 2013).

In order to evaluate the hypoglycemic activity of crude extract of *Costus igneus* leaves authors performed this study. And they have concluded that extract showed effectiveness on L6 cell which was compared with standard rosiglitazone. With this authors mentioned that extract does not have cytotoxicity (Swarnalath. Y et al).

8. CONCLUSION

In Ayurveda *Costus igneus* or ‘insulin plant’ is reported as one of the very important medicinal plant. According to literature it is cultivated in India and used as a potent herbal cure for diabetes as well as ornamental plant. In the present review, an attempt has been made to conclude the biological activities, chemical constituents (phytochemistry), occurrence, and ethnopharmacology of *Costus igneus*. Different extracts from various parts of plant have been reported for many potent biological activities. Formulations of *Costus igneus* such as silver nano particles were also found very effective against microbes. Various types of constituents (β-amyrin, diosgenins, and quercetin etc) are isolated and they have good effect on prevention or inhibition of diseases. Antidiabetic effect of *Costus igneus* leaves currently has been tested in diabetic patients. Still, there are many areas remaining to explore such as pharmacokinetic profile and formulation development, using plant extracts which needs to be explore in more elaborative way.

9. ACKNOWLEDGMENT:

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10. REFERENCES


Potential Sources of Anticancer Agents. Natural Product Chemistry and Research, 4, 2.


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