Review Article

CostusIgneus: a review on insulin plant and its remedial approaches

ABSTRACT

CostusIgneus is a medicinal plant. This plant mostly known as a decorative plant in India, Costusigneus, it is often called the spiral flag is a member of the Costaceae family and has become known as the "insulin plant" because of its purported capacity to increase the manufacturing of insulin considering the growing demand for natural medicines to treat diabetes mellitus and there is increasing curiosity for plant-based medicine. Alkaloids, terpenoids and flavonoids are among the many phytochemicals that have been shown to be present in Costusigneus. The biological characteristics of Costus are taken in this review paper. Costusigneus shows many pharmacological activities such as anti-diabetic, antimicrobial activity, anticancer effect, hypolipidemic activity, antioxidant activity, hepatoprotective action, adaptogen activity and the role of neuroprotection.

Keywords: Costusigneus, costaceae, insulin plant, spiral flag, antihyperglycemic agent, antidiabetic agent.

1. INTRODUCTION

Native to South and Central America, Costusigneus Nak (also known as Costus pictus D. Don, Costus mexicanus Liebm ex Petersen, or Costuscongenitus Rowle) is sometimes referred to as a "fiery costus", "step ladder", "spiral flag" or "insulin plant". This plant was brought to India from America recently as a natural remedy for diabetes. In South India, it is commonly planted as a decorative plant in gardens and may also be found growing wild in various locations[1]. It is used to treat diabetes in India and if diabetic patients will consume one leaf each day it can be maintain low blood glucose levels [2]. The tribal inhabitants of the Kolli Hills in the Namakkal district of Tamilnadu are known to employ the leaves of C. igneus as one of the plants that effectively treat diabetes [3]. Sources of C. speciosus that, in a dose-dependent manner, prevent the proliferation of many cancer cell types including liver, colon and prostate cancer cells based on studies using methanolic, ethanolic, water and ethyl acetate extracts of costusplant[4].

A prolonged hyperglycemia level is a hallmark of diabetes mellitus, a chronic endocrino-metabolic condition that can be caused by either insufficient insulin synthesis or release by B cells (type 1 diabetes) or inefficient insulin use by the cells (type 2 diabetes). Diabetes results in changes to several biomolecules, including proteins, fats and carbohydrate which in turn induce hyperglycemia, glycosuria, hyperlipidemia and atherosclerosis. Hepatic

impairments are among the additional adverse outcomes that develop as a result of persistent hyperglycemia and inflammation[5].

Complex compounds with a broad range of biological activity and significant potential therapeutic value can be found in abundance in natural goods. One of the ancient practices that people have accepted is the use of medicinal plant extracts to treat a variety of diseases. Phytochemicals found in medicinal plants make them effective for both healing and curing human illnesses. Alkaloids and other phytochemicals such as flavonoids, coumarins, glycosides, polysaccharides, phenols, tannins and terpenoids are produced by plants as part of their regular metabolic processes. These phytochemical substances have anti-inflammatory or disease-preventive qualities. Flavonoids are widely recognized for their antioxidant properties. Flavonoids have demonstrated antimicrobial, anti-cancer and antiallergy properties. The body produces free radicals when there is an imbalance between Reactive oxygen species (ROS) and antioxidants[6].

2. PLANT DESCRIPTION

It is a perennial plant with an erect growth habit that touches the ground and extends outward. Simple, oblong, alternating and evergreen the leaves have parallel veining and reach a maximum length of 4 to 8 inches. This tropical evergreen plant which grows in clusters from underground rootstocks is adorned with large, smooth, spiral-arranged dark green leaves with pale purple undersides. It produces stunning 1.5-inch orange flowers that resemble cones that emerge from the tops of branches during the summer months. The plant is a rhizomatous shrub, meaning that its subterranean tuberous rhizome pierces the ground. The meaty, spongy, cylindrical rhizome has a smooth, pale brown surface with a temperature range of 30-40 degrees Celsius. The plant has a pleasant odor[7].

2.1 Biological source.

It is composed of both dried and fresh leaves from the Costaceae family plant, CostusIgneus[8].

2.2 Geographical origin

Southeast Asia, especially the bigger Sunda Islands in Indonesia is Costusigneus natural habitat. West Bengal and other regions of India are also home to it. In southern India the plant is already being utilized as a dietary supplement to treat diabetes[8].

3. TAXONOMY AND VERNACULAR NAME [9].

Table 1: Taxonomic classification and vernacular names of Costus speciosus-

Item	Name
Taxonomic classification	
Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Sub class	Zingiberidae
Order	Zingiberales
Family	Costaceae
Genus	Costus
Species	Speciosus
Vernacular names	

Sanskrit	Kembuka, Kebuka, Kembu
English	Crepe ginger
Hindi	Keu, Keukand, Kemuka, Kemua
Marathi	Penva, Pinnha, Kobee, Peva
Guajarati	Paskarmula, Valakdi
Bengali	Keu, Keumut
Tamil	Kostam
Assam	Tara
Kannada	Changalvakostu, Chikke
Telegu	Kashmeeramu, Cengalvakostu
Malayalam	Channakoova
Latin name	Costus speciosus
Classical name	Kebuka

4. PHYTOCHEMICAL CONSTITUENT

Alkaloids, terpenoids and flavonoids are among the many phytochemicals that have been shown to be present in Costusigneus. These bioactive compounds are found in the leaves, stems, rhizomes and other plant parts such as flowers.

4.1 Leaves: Among other compounds leaves include proteins, carbohydrates, alkaloids, triterpenoids, tannins, saponins and flavonoids. In addition leaves include carbohydrates and fatty acids including hexadecanoic acid, oleic acid, ethyl oleate tetradecanoic acid, 9–12 octadecanoic acid and squalene.

4.2 Stem: Stem includes the steroid component such as stigmasterol as well as the terpenoid molecule lupeol.

4.3 Rhizome: Quercetin, diosgenin, asteroidal sapogenin and other substances are found in rhizomes.

4.4 Root: Terpenoids, alkaloids, tannins and other substances are found in roots[10].

5. GROWTH AND PROPAGATION

Spiral flags may grow in partial shade or full sun. It is frequently grown close to water and requires rich soil and lots of moisture. Clumps, cuttings or offsets or plantlets that develop beneath the flower heads can all be divided to propagate the plant. Nematodes and mites can be an issue, particularly in light, sandy soil. There are no serious illnesses affecting the plant[11].

6. TRADITIONAL USES

6.1 Leaves

For a month, diabetics were encouraged by Ayurveda to incorporate leaves from the insulin plant into their daily regimen. During the first week, they were first told to chew four leaves per day—two in the morning and two in the evening—to ensure complete mastication before to consumption. The dosage was then lowered to two leaves daily, one in the morning and one in the evening and this schedule was followed for a total of thirty days. This approach worked well for controlling blood sugar levels. Additionally, these leaves have traditionally been used to cure respiratory disorders including bronchitis and asthma, improve general health and longevity, treat skin diseases, lower fever and get rid of intestinal parasites

6.2 Rhizome

The insulin plant's rhizome has a variety of functions and characteristics including aphrodisiac, astringent, acrid, bitter, cooling, febrifuge, depurative purgative, and expectorant effects. Burning sensations, constipation, leprosy, worm infections, skin disorders, fevers, asthma, bronchitis, inflammations and anemia are among the illnesses it helps to cure [12].

Fig.1.Costus Igneus plant

Fig. 2. Rhizomes of Costusigneus

7. PHARMACOLOGICAL ACTIVITY

CostusIgneus shows the many pharmacological activity. Such as antidiabetic, antimicrobial activity, anticancer effect, hypolipidemic activity, antioxidant activity, hepatoprotective action, adaptogen activity and the role of neuroprotection.

7.1 Antidiabetic activity

The insulin plant has the potential to prevent diabetes. In a clinical investigation, diabetics who took one fresh leaf or one teaspoon of shade dried powder of C. igneus each day, together with other therapies, were able to effectively control their blood sugar levels[13]. By activating beta cells. It is thought that the insulin plant's leaves stimulate the pancreatic beta cells, increasing the body's natural production of insulin.

7.2 Antimicrobial Activity

Numerous microorganisms, such as multidrug-resistant
Gram-positive and Gram-negative bacteria, Citrobacter species, Proteus mirabilis,
E. coli, Klebsiella pneumoniae, Staphylococcus aureus, Enterococcus faecalis and Candida albicans are susceptible to the antimicrobial activity of Methanolic Extract of the rhizomes of Costusigneus[14].

7.3 Anticancer activity

In vitro mammalian (HT-1080) cells were shown to have anti-proliferative and anti-cancer properties when exposed to an ethanolic extract of C. igneusleaves[15]. Every bark extract exhibited strong anti-cancer effects on HT 29 and A549 cells[16].

7.4 Hypolipidemic Activity

Total cholesterol, low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL), phospholipids and triglycerides can all be considerably lowered by using ethanolic leaf extract from Costusigneus. Additionally, it can raise high-density lipoprotein (HDL) levels[17].

7.5 Antioxidant activity

Costusigneus leaf, stem and rhizome extracts have antioxidant properties. Costusigneus has a significant level of antioxidant activity. The plant's ethanolic extract had the highest level of antioxidant activity, whereas the aqueous extract displayed the lowest[18].

7.6 Hepatoprotective action

Liver enzymes such serum alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) can all be improved by costusigneus[19]. Costusigneus root powder and ethanolic extract protect rats livers against carbon tetrachloride (CCl4)-induced injury. The roots also enhanced biochemical assessments, such as serum liver enzymes, renal functions, lipid profiles and oxidative enzymes[20]. When C. speciosus ethanolic extract was given orally to wister albino rats, the same results were seen as when silymarin, a common medication with hepatoprotective properties was also used[21].

7.7 Adaptogen activity

The central and peripheral nervous systems neurotransmitters are impacted by stress, which lowers dopamine and norepinephrine levels in the brain[22]. Monoamine oxidase (MAO) is essential for controlling biogenic amines, especially when it comes to blocking serotonin (5HT) release[23]. Stress causes norepinephrine levels to rise, which raises dopamine levels. C. speciosus extracts considerably lower the stress-induced elevations of serotonin and its metabolite 5-HIAA in brain tissues via inhibiting the stress response[24].

7.8 The role of neuroprotection

The neuroprotective effects of Costusigneus extract on the brains of female diabetic rats caused by streptozotocin. The plant extracts considerably decreased the amount of lipid peroxidation thiobarbituric acid reactive substances (TBARS) in brain tissue. Furthermore, the extract lowered the levels of antioxidative enzymes such superoxide dismutase (SOD), catalase (CAT) and reduced glutathione (GSH). By boosting the number of glial and astrocyte cells, they showed a notable recovery from diabetes-induced brain problems[25].

7.9 Diuretic effect

A research compared the diuretic effect of an aqueous extract of C. pictus D. Don (doses of 100 and 200 mg/kg body weight) to that of furosemide (4 mg/kg). The study found that C. pictus had a natriuretic effect similar to furosemide. The aqueous extract increased salt and potassium clearance, similar to furosemide, indicating considerable diuresis[26].

7.10 Hypoglycemic activity

The ethanolic extract of Costusigneus (whole plant) was tested on alloxan-induced diabetic albino Wister strain rats to see how it affected blood sugar levels[27]. Diabetic mice treated with 250 mg/kg ethanolic extract of Costus igneous showed a reduction in increased blood glucose levels[28].

7.11 Effect of costusigneus on learning and memory

Diabetic rats given an ethanolic extract of Costusigneus demonstrated enhanced learning and memory. In a passive avoidance test, the treated rats entered the dark area faster and spent less time in the darkroom [29]. The therapy with Costusigneus dramatically lowered blood sugar levels in diabetic rats [30].

7.12 Anti-inflammatory action

The methanolic extract of Costusigneus demonstrated an anti-inflammatory and strong analgesic effect in experimental rats[31].

8. Conclusion

Costusigneus is a commonly used medicinal herb. The existence of important phytochemical ingredients such as diosgenin, corsolic acid, beta-sitosterol, beta-amyrin, quercetin and others, as well as their pharmacological actions, shown that the plant has a leading capability for the production of innovative and effective medications in the future.

References

1. Hegde PK, Rao HA and Rao PN: A review on Insulin Plant (Costusigneus Nak). Pharmacognosy reviews. 2014; 8(15): 67.
2. Devi VD, Urooj A. Hypoglycemic potential of Morus indica. L and Costus igneous. Nak: A preliminary study. Indian J Exp Biol 2008;46:614□6.
3. Elavarasi S, Saravanan K. Ethnobotanical study of plants used To treat diabetes by tribal people of Kolli Hills, Namakkal District,Tamilnadu, Southern India. Int J Pharm Tech Res 2012;4:404□11.
4. El-Far A, Badria F, Shaheen H. Possible Anticancer mechanisms of some Costus Speciosus active ingredients concerning drug Discovery. Curr Drug Discov Technol. 2016;13(3): 123–43.
5. Younis Ahmad Hajam a, Rajesh Kumar, Mohd Salim Reshi. Administration of Costusigneus Nak leaf extract improves diabetic induced impairment in hepatorenal functions in male albino rats Journal of King Saud University – Science 34 (2022) 101911.
6. Waseem Iqbal Khanday, Nazir Ahmad Wani, Balaji Paulraj Antioxidant and Cytotoxic Potential of Leaf Extracts of Costusigneus 2019 Journal of Natural Science, Biology and Medicine.
7. Pranita M. Kankariya, Nishigandha N. Dhokale, Nisha K. Purkar, Rajshree R. Darade and Prasad S. Dhamane. A review on Costusigneus or insulin plant World Journal of Pharmaceutical Research Vol 13, Issue 16, 2024, 429-442.
8. Meléndez-Camargo ME, Castillo-Nájera R, Silva-Torres R, and Campos-Aldrete ME. Diuretic action of an aqueous extract of Costus pictus D. Don in rats. Proc West Pharmacol Soc, 2006; 49: 72–4.
9. El-Far AH, Shaheen HM, Alsenosy AW, El-Sayed YS, Jaouni SK, Mousa SA. Costus speciosus: Traditional uses, phytochemistry, and therapeutic Potentials. Phcog Rev 2018;12:120-7.
10. V. Sai Tanushree soni, Meghna Shrivastava, biological activities of insulin plant: Costusigneus. Recent Trends in Chemical, Agricultural, Biological, Environment and Life Science. ISBN: 978-91-7308-086-6.
11. Gilman EF. Costusigneus. Fact sheet. FPS□151. EDIS□Electronic Data Information Source□UF/IFAS Extension. Florida: University Of Florida, Inc.; c2012.
12. B Chetana M. V., Pramod N. Patil, TairabiKhandal, Basavaraj Padmashalia. CostusIgneus: a review of biological potential. African journal of biological sciences Afr.J.Bio.Sc.6.12(2024).
13. Bhatt N et al., Comparative Review of two Anti-Diabetic Herbal Drugs – GymnemaSylvestreandCostusIgneus. American Journal of Pharm Tech Research 2014.

14. Nagarajan, A., Arivalagan, U., and Rajagurua, P. (2011). In vitro root induction and studies on Antibacterial activity of root extract of Costusigneus on clinically important human pathogens. Journal of Microbiology and Biotechnology Research, 1(4), 67-76.
15. Nadumane VK, Rajashekar S, Narayana P, Adinarayana S, Vijayan S, Prakash S, et al. Evaluation of the anticancer Potential of Costus pictus on fibrosarcoma (HT□1080) cell line. J Nat Pharm 2011;2:72□6.
16. Sathuvan M, Vignesh A, Thangam R, Palani P, Rengasamy R, Murugesan K. In vitro antioxidant and anticancer potential Of bark of Costus pictus D.Don. Asian Pac J Trop Biomed 2012;2:S741□9.
17. Kalailingam P, Kaliaperumal R, Shanmugam K and Tamilmani E: Efficacy of Methanolic Extract of CostusIgneus rhizome on hypoglycemic, hypolipidimic activity in Streptozotoc in (STZ) diabetic rats and HPTLC analysis of Its active constituents. ICBBB 2011; 318-21.
18. Ramya Urs SK and Chauhan JB: Phytochemical screening, Antimicrobial activity and Antioxidant activity of CostusIgneus. European J Mole Bio and Bioche 2015; 2(2): 93-6.
19. Contreras□Zentella ML, Hernández□Muñoz R. Is liver enzyme release really associated with Cell necrosis induced by oxidant stress? Oxid Med Cell Longev2016;2016:3529149
20. Biman B, Kamaruz Z. Evaluation of hepatoprotective activity of rhizomes of Costus Speciosus (J. Kanji) Smith. Pharmacology online 2008;3:119□26.
21. Verma N, Khosa RL. Evaluation of protective effects of ethanolic extract of Costus Speciosus (Koenig) Sm. Rhizomes on carbon tetrachloride induced hepatotoxicity in rats. Natl Prod Radiance 2009;8:123□6.
22. Padma P, Chansauria JP, Khosa RL, Ray AK. Effect of Annooa muricata and PolyalthiaCerasoides on brain neurotransimitters and enzyme monoamine oxidase following cold Immobilization stress. J Natl Remedies 2001;1:144□6.
23. Verma N, Khosa RL. Effect of Costus speciosus and Wedelia chinensis on brain Neurotransmitters and enzyme monoamine oxidase following cold immobilization stress. Pharm Sci Res 2009;1:22
24. Joseph M, Kenneth GA. Stress□induced release of 5HT in the hippocampus and its Dependence on increased tryptophan availability: An in vivo electrochemical study. Brain Res 1983;270:251□7.
25. Gupta D, Rai S, Hajam YA et al. Neuroprotective Role of Exogenous Melatonin and Insulin Plant (Costusigneus nak.) Extract on Brain in Streptozotocin-Induced Diabetes in Female Rat. Research & Reviews: A Journal of Pharmacognosy. 5, 2018, 33–41.
26. Mrs. Pooja Suresh Thorat1, Mr. Onkar Sachin Deshmukh2 et.al Overview Spiral Flag International Journal Of Progressive Research In Engineering Management And Science (Ijprems)Vol. 04, Issue 01, January 2024, Pp : 468-472.
27. Palanivel, V., Mohamed Jihad, E. V., & Senthil Kumar, K. L. (2013). Evaluation of hypoglycemic activity of Costusigneus extract (whole plant) on alloxan induced diabetic rats. International Journal of Advanced Pharmaceutical Genuine Research, 1(2), 9-19.
28. Iyyappan Arivu, 2minnady Muthulingam And 3govindaraj Selvakumar Detailed Study OnCostusIgneus Plant For Its Medicinal Importance - A Review International Journal

Of Zoology And Applied Biosciencesissn: 2455-9571 Volume 8, Issue 1, Pp: 34-39, 2023.
29. Lavanya Athilli, A. Fatimah Siddiqui, Fahad Hussain and Eenaz Ajaz Hussain Parvez Pharmacognostic Study and Pharmacological Potentials of CostusIgneusPlant – Review International Journal of Pharmacognosy Athilli Et Al., Ijp, 2021; Vol. 8(12): 476-486. E- Issn: 2348-3962, P-ISSN: 2394-5583.
30. Chetty S, Adiga S and Reddy S: Evaluation of the effect of Costusigneus on learning and memory in normal and diabetic rats using passive avoidance task. Int J Pharm Pharm Sciences 2014; 6(2).
31. Srivastava, S., Singh, P., Jha, K. K., Mishra, G., Srivastava, S., & Khosa, R. L. (2013). Antiinflammatory, analgesic and antipyretic activities of aerial parts of Costus speciosus Koen. Indian Journal of Pharmaceutical Sciences, 75(1), 83.