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PHYTOCHEMICAL AND PHARMACOLOGICAL OVERVIEW OF *CHEMOECOSTUS CUSPIDATUS*

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Abstract

Medicinal plants have been proven to be potential source for therapeutic discoveries. This has led to development of world's most commonly used drugs. *Chemoecostus cuspidatus* (Nees & Mart.) C.D. Spech & D.W. Stev. (Costaceae) a monocot plant native of eastern Brazil. It has been commonly known as "insulin plant", traditionally it has been widely used for its antidiabetics (in Phillippines, Siddha medicine, tribes of Kolli hills), renal disorders (in Mexico) and anti-inflammatory action (Siddha Medicines). As *Chemoecostus genus* spits off from *Costus* in 2006.

This review provides an overview of the Phytochemical and pharmacological activities of *Chemoecostus cuspidatus.* The data compiled highlights, *Chemoecostus cuspidatus* to be potential source of phytochemical's having pharmacological actions which can acts as templates for future studies of lead compound in drug.

Key words: monocotplant, Antidiabetic, renal disorders, Anti-inflammatory action.

Introduction

Natural products and their related moieties have used as lead in potential drug development potential drug development owing their low cost, less time and visibly no side effect. Through there is a rise in combinatorial drug discovery, cellular and molecular level for precision in targeting of drug molecules, still role of phytochemicals holds its place in the providing new leads for various ailments. Genus Chamaecostus is in the family *Costaceae* in the major group *Angiosperms* (Flowering plants) and was split off from costus in 2006 in reference to the work of HIS Board member Chelsa Specht (Specht and Stevenson, 2006). *Chemoecostus cuspidatus* (Nees & Mart.) is a rhizomatous shrub and penetrates through the tuberous rhizome. Rhizome is about 20-40cm grown, cylindrical, soft and fleshy with the smooth pale brown surface with the pleasant aromatic smell. Leaves are green in colour, length about 15-25cm, narrow, several parallel equal thick veins (Kalailingam *et al*., 2010). The first collection reported in 1857 by Gallo at (14º10'00"s) latitude and (053º05'00"w) longitude (Collection Number-7199). Scientific synonyms are *Chemoecostus cuspidatus* (Nees & Mart) maas, Globba cuspidate Nees and Mart and *Costus igneus* N.E. Br (theplantlist.org).

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During an Ethano botanical study in 2012, Elavarasi S. and Sararvanan K., through an oral interview investigate the anti diabetic use of *Chemoecostus cuspidatus* by Tribal People of Kolli Hills, Namakkal District,Tamilnadu (Elavarasi and Sararvanan, 2012). Rhizomes have been used to treat fever, rash, asthma, bronchitis, intestinal worms, ailments of eyes, stomach, neck, jaws, tongue, mouth (Sarvanan *et al*., 2014). For several years intensive research has been carried out on *Chemoecostus cuspidatus* (Nees & Mart.). The objective of this review is to provide an overview of the Phytochemical and pharmacological activities of *Chemoecostus cuspidatus*. This review includes all the *in-vitro* and *in-vivo* studies on Diabetes, renal disorders and anti-inflammatory diseases etc. The data compiled highlights, *Chemoecostus cuspidatus* to be potential source of phytochemical's having pharmacological actions which can acts as templates for future studies of lead compound in drug.

Regional Names of Insulin Plant

Bengali-Piasal

Hindi-Banda, Bija-sal, Peisar, JARUL, Keukand

Kannada-Kempu hone

Malayalam- Honne, Karintakara, Vengai, Venna-maram

Marathi-Honi, Pushkarmula

Odisha-Vengis

Sanskrit-Asana, Bandhukapushpa

Tamil-Neyccarikamaram, Venkai-c-ciray, Kostam

Telugu-Peddavesiga, Yeangesha

Urdu-Bijasar, Dam al akhwain

Gujarati-Pakarmula

English-Banaba.

Taxonomy

Botanical name:*Chemoecostus cuspidatus* (Nees & Mart.) C.D. Spech & D.W. Stev. (Costaceae)

Domain: Eukaryota

Kingdom: Plantae

Subkingdom: Viridaeplantae

Phylum: Tracheophyta

Subphylum: Euphyllophytina

Infraphylum: Radiatopses

Class: Liliopsida

Subclass: Commelinidae

Superorder: Zingiberanae

Order: Zingiberales

Family: Costaceae

Subfamily: Asteroideae

Tribe: Coreopsideae

Genus: Chamaecostus

Specific epithet: cuspidatus

Pharmacological Activities

• **Toxicity study:** The US Food and Drug Administration (FDA) states that it is requisite to do research to find new molecules for pharmacological activity and toxicity potential in animals (21 Code of Federal Regulation Part 314). Administration of ethanolic extract of *Chemoecostus cuspidatus*leaves from dose of 50 mg/kg b.w up to the dose of 5000 mg/kg b.w did not show significant toxicity signs during the first four hours and followed by daily observations for 14 days and no mortality was also observed; the drug was found to be safe at the tested dose level of 5000 mg/kg b.wt. (Khanday *et al.*, 2019). Study carried out on the methanolic extract of *Costus igneus*, findings showed toxicity at 250 mg/kg body weight (Devi and Urooj, 2011). In a seperate study of acute toxicity studies animal tolerate maximum dose of 1000mg/kg b.w. for aqueous and ethanolic extract of stem part of *Chemoecostus cuspidatus*. In same study two isolated compound lupeol and stigmasterol, at dose of 500g/kg showed no apparent behavioral change in all groups (Manjula *et. al.*, 2012).

• **Anti-inflammatory Activity:** Inflammation, a pathological condition which underlies arthritis, cardiovascular, diabetes mellitus, cancer and chronic inflammatory disease (Linlin Chen, *et al.*, 2018).

Prostaglandins and leukotrienes are inflammatory interceders (Cornejo-García *et al.*, 2016) biologically synthesized by cyclooxygenases (COX) and lipooxygenases (LOX) in many cell types and are throughly associated with inflammatory disorders. COX monitors the downstream regulations of immune cell activation and inflammatory cytokine induction (Turner, M.D. *et al.*, 2014). LOX is useful in leukotrienes biosynthesis (Ting Liu, *et al.*, 2017).

Nuclear factor kappa (NF-κB), a transcription factor marks a important role in immune system (Giuliani *et al.*, 2018). NF-κB dimer is activated when IKK mediated phosphorylation (Shih *et al.*, 2015*)* induces proteosomal degradation of the IKB inhibitor enabling the active NF-κb transcription factor subunits to relocate to the nucleus and induce target gene expression of proinflammatory gene such as i-NOS, TNF-α, IL6, COX-2 (Gullick and scott, 2011).

NF-κB signaling plays a key role in inflammation so road blocking of NF-κB plays a vital role in therapeutic application (Ting Liu, *et al.*, 2017).

Costus speciosus, other species of this genera, is among the most effective Islamic traditional medicine (Emami *et al.*, 2016). This is mainly recommended as a remedy for pharyogitis, tonsillitis in children and pleurisy.

As per study carried out by Krishnan *et al.*, various extracts took in initial study but methanolic extract of *Chemoecostus cuspidatus* shows maximum anti inflammatory effect in rats induced with carrageenan. MEC exerted edema inhibition of 69 and 80 at 3 and 5hours, respectively. Pretreatment of MEC decreases COX, lipoxy genases (LOX,5-LOX) activity in isolated mononuclear cells. MEC also decreases myeloperoxidase (MPO), nitric oxide synthase (NOS) activity. Same study elucidated β-amyrin effect in LPS challenged hPMBC and, at dose of 20µg, reduced PGE-2 concentration at a significant level as compared to other doses (Krishnan *et al.*, 2014). Therefore *Chemoecostus cuspidatus* can be used for anti-inflammatory diseases.

• **Nephrolithiasis:** Kidney stone is a paramount disorder. Kidney stone has a consortium with increased plausibility of chronic kidney (Sigurjonsdottir, 2015) disease and stage renal failure (Mikawlrawng, 2014 and Dhondup *et al.*, 2018), Cardiovascular disease (Ndrepepa, 2018), diabetes and hypertension

Table 1: Ethanobotanical Uses of Chamaecostus cuspidatus.

Plant Part Used	Traditional Uses	References
Rhizome	To treat fever, rash, asthama, bronchitis, Intestinal worms, ailments to eyes, stomach, neck, jaws, tongue, mouth, edema, wheezing (dyspnoea) Haemorrhoids, spermaturia	A. Sarvanan *et al*., 2014
Leaves	Leaves juice is used to treat diabetes	T. Thirumalai *et al.*, 2012 and S. Elavarasi *et al.*, 2012
Root	Used in Siddha medicine system, as Powder (Choornam), decoction (Kudineer) and oil (Thylam)	Arun Nagarajan *et al*., 2011

(Sigurjonsdottir, 2015). Reoccurrence rate is higher in male as compared to female (Afsar, *et al*., 2016). Various kidney stone locations in urinary system are pelvic, calyx, staghorn, mid ureteral bladder (Evan, 2010).

Nature of the Kidney stone depends on anomalies in urine composition of various chemicals. Based on mineral composition and pathogenesis, kidney stone classification is as follows: Calcium stone, struvite or magnesium ammonium phosphate, Uric acid stone or Urate, Cystine stone, Drug induced stone (Tilahun and Beyene, 2018). Preponderant renal stones, Calcium oxalate/Phosphate embrace 80% of all urinary calculi (Liu *et al.*, 2018). Pure Calcium oxalate proportion in calcium stone may account to 50% (Tilahun *et al.*, 2018 and Liu *et al.*, 2018) and is found in majority of kidney stones and subsist in the form of Calcium oxalate monohydrate and calcium oxalate dihydrate or 60% accounts for combination of both. As calcium oxalate monohydrate is thermodynamically sturdy and frequently spotted in clinical stone (Singh and Rai, 2014). A *in-vitro* study carried out with aqueous extract of *Chemoecostus cuspidatus* leaves, stem and rhizomes in calcium oxalate crystals reduce to a size of crystal from 2.15 to 0.07g (Manjula *et al.*, 2012), as concentration increased from 0.15% to 1.00% w/v. In a study carried out by Manjula *et al*., aqueous and ethanolic extract of *Chemoecostus cuspidatus* showed significant decrease in deposition of stone forming constituents, similarly isolated compounds lupeol and stigmasterol at dose 50 and 100mg/kg were significantly lower urolithiatic in rats (Manjula *et al*., 2012).

• **Antihyperglycemic Activity:** The WHO estimated 422 Million adults have diabetes, 1.6 million deaths are directly attributed to diabetes each year, 1 in 3 adults aged over 18 years is overweight and 1 in 10 is obese (http://www.who.int/diabetes/en/). Studies found a strong association between prevalence of diabetes and obesity. Genetic factors partly determine the risk of type 2 diabetes (Akhtar and Dhillon, 2017). A study on Indian data shows that a rapid socioeconomic development and demographic changes, with increase susceptibility for Indian individuals, led for boost cases of Diabetes Mellitus in last four years (Unnikrishnan *et al*., 2016). *Chemoecostus cuspidatus* has been used as an Antidiabetic drug in various studies (Kalailingam *et al*., 2011; Bhat, 2010; Mani, 2010; Shetty, 2010; Devi, 2011; Krishnan *et al*, 2011).

In a cross- sectional clinical study, patients consuming either one fresh leaf or 1 teaspoon of shade-dried powder/ day of *Chemoecostus cuspidatus* in convergence with other modalities of treatment had effectively produced glycemic control in diabetics (Remya and Daniel, 2012).

Fig. 1: Distribution of *Chaemososstus* genera with *Chaemocostus igneus* species.

Table 2: Evaluation of Pharmacological Activities.

Bioactivity Assay	Plant Part	*Test System*	Extracting Solvent	Test Organism/ Model/Method	Control	Toxicity Test	Reference
Antidiabetic	Leaves	*In-Vivo*	Acetone Hexane Water	Adult Wistar albino Rats	Glibeclamide	NA	Khanday, W.I. *et al.*, 2019
Toxicity	Leaves	*In-Vivo*	Acetone Chloroform Ethyl Acetate n-Butanol Hexane Water	Male swiss mice		Acute (MTD)	Khanday, W.I. *et al.*, 2019
Antimicrobial	Leaves	*In-Vitro*	Ethyl Alcohol	Disc diffusion method	Ampicillin (antibacterial) and Griseofilvin (antifungal)	NA	Rao, N.B. *et al.*, 2016
Anti Bacterial	Leaves	*In-Vitro*	Hexane	Agar well diffusion method	Gentamycin	NA	Rajshree, K. & Chitra, P. 2016
Antimicrobial	stem	*In-Vitro*	Methanolic	Agar well diffusion method	Gentamycin		Ramya Urs, S.K. *et al.*, 2015
Antimicrobial	Root	*In-Vitro*	Methanolic	Agar well diffusion method	Gentamycin		
Antimicrobial	Rhizome	*In-Vitro*	Methanolic	Disc diffusion method	Streptomycin, Sulphamethazole, Ampicillins		Sardessai, Y. *et al.*, 2014
Anti Bacterial	Leaves	*In-Vitro*	Pet ether Chloroform Methanolic Ethyl Acetate	Disc diffusion method & Agar well diffusion method	Nystatin	NA	Kala, S. 2014
Anti Bacterial	Root	*In-Vitro*	Pet ether Chloroform Methanolic Ethyl Acetate	Disc diffusion method & Agar well diffusion method	Nystatin	NA	
Anti Bacterial	Stem	*In-Vitro*	Pet ether Chloroform Methanolic Ethyl Acetate	Disc diffusion method & Agar well diffusion method	Nystatin	NA	
Antidiabetic	Leaves	*In-Vivo*	Ethanolic	Wistar albino Rats (Dexamethasone)	Glibeclamide	NA	Shetty, A.J. *et al.*, 2010
Hepatoprotective	Leaves	*In-Vivo*	Ethanolic	Wistar albino Rats	silymarin	NA	Chacko N. *et al.*, 2012
AntiInflammatory	Leaves	*In-vitro*	Hexane Ethyl Acetate Ethanolic	Inhibition of albumin denaturation	Salicylic Acid	NA	
Antidiabetic	Leaves	*In-Vivo*	Ethanolic	Adult albino wistar rat (Alloxan)	Glibenclamide (600µg/kg)	Acute (Maximam tolerated Dose)	Vishnu Bhat *et al.*, 2010

As per an oethanobotanical study exicuted, Javadhu hills, Tamilnadu, India, Leaves juice of *Chemoecostus cuspidatus* is used for the treatment of Diabetes (Thirumalai *et al.*, 2012). This plant is also used by Kolli hills, Namakkal district, Tamil Nadu, southern India as a anti-diabetic plant (Elavaras and Saravanan, 2012).

Table 3: Important Bioactive isolated from Costus igneus.

Phytochemicals	Biological activity	Extract	Plant Part	References
Insulin Like Protein	Hypoglycemic activity	acidified ethanolic extract		Hardikar, M.R. *et al.*, 2016
Lupenol	Anticancer, antiprotozoal, chemopreventive and anti-inflammatory properties		leaves	Manjula, K. *et al.*, 2012
Stigmasterol	anti-peroxidative and hypoglycemic effects		leaves	Manjula, K. *et al.*, 2012
Quecertin	antioxidant, antiviral, anticancer,antimicrobial, anti-inflammatory	Methanol		Pazhanichamy, K., 2012
Kaempferol	antioxidant, antiviral, anticancer,antimicrobial, anti-inflammatory	Methanol		
Protein	Enzyme activity			Shankarappa *et al.*, 2011 and Triruchenduran *et al.*, 2016
Iron	Iron-deficiency			
Ascorbic Acid	Vitamin C- deficiency			
α-tocopherol	vitamin E activity			
β-Carotene	precursor of retinol			
Steroids	Precursor for sex hormones, adrenal cortical hormones, bile acids, and sterols	Ethanol	Stem	R. Saraswathi *et al.*, 2010
Phytol	Antinociceptive and Antioxidant Activities	aqueous	leaves	Tominaga *et al.*, 1998
cis-9,10-Epoxyoctadecan-1-ol	antimicrobial activity, antipest activity etc.	aqueous	leaves	
Oleyl alcohol	antimicrobial activity	c	leaves	
(Z)-14-tricosenyl formate	antibacterial and antifungal activity	aqueous	leaves	
Dodecanal	antimicrobial activity	aqueous	leaves	
Tridecanal	antimicrobial activity	aqueous	leaves	
Undecanal	antimicrobial activity	aqueous	leaves	Tominaga *et al.*, 1998
Hexadecanedi-1,16-ol	antimicrobial activity	aqueous	leaves	
Undecanoic acid, 2-methyl	antimicrobial activity	aqueous	leaves	
Decanoic acid, 2-methyl	antimicrobial activity	aqueous	leaves	
Octanoic acid, 4-methyl, methyl ester	antimicrobial activity	aqueous	Leaves	
Acetamide, 2-amino	antimicrobial activity	aqueous	Leaves	
Urea, butyl	antimicrobial activity	aqueous	Leaves	
Octanoic acid, 2-methyl-	antimicrobial activity	aqueous	Leaves	
Butanoic acid, 2-methyl-	antimicrobial activity	aqueous	Leaves	
Pentanoic acid, 2-methyl-,butyl ester	antimicrobial activity	aqueous	Leaves	
Decanoic acid, 10-fluoro-, trimethylsilyl ester	antimicrobial activity	aqueous	Leaves	

Concurrently, a wide range of *in-vitro* and *in-vivo* test has been used to evaluate the anti-diabetic property of *Chemoecostus cuspidatus* (Table 2).

• **Hypolipidemic activity:** A study was carried out to evaluate the methanolic and aqueous extracts of *Chemoecostus cuspidatus* in diabetes-induced hyperlipidemia in rats comparitively. The study brought to light that methanolic and aqueous extracts at a dose of 200 mg/kg body weight switched the diabetes-induced hyperlipidemia (Bhat *et al.*, 2010). Alcoholic extract of *Chemoecostus cuspidatus*at the dose of 400 mg/kg (p.o) had significantly decreased the levels of serum cholesterol, triglycerides, LDL in Triton-induced hyperlipidemic rats (Chacko *et al.*, 2012).

• **Antimicrobial Effect:** Methanolic extract of

Chemoecostus cuspidatus portrayed maximum anti-bacterial activity against *gram-positive Bacillus cerus, Bacillus megaterium, Micrococcus leuteus, Staphylococcusn aureus, Streptococcus lactis* and gram-negative strains *Pseudomonas aeruginosa, Escherichia coli, Enterobacter aerogenes, Klebsiella pneumoniae* and *Salmonella typhimurium*. The isolated compound extracted from the ethanolic extract of *Chemoecostus cuspidatus* showed moderate anti-bacterial and anti-fungal activity against *Staphylococcus aureus, Eschericia coli* and *Candida albicans* (Arun *et al.,* 2011). Further in continuation to the antimicrobial activity some other studies (Given in Table 2) also plays major role in finding impactful results of anti microbial effects of *Chemoecostus cuspidatus.*

• **Anticarcinogenic:** Traditional Indian medicinal system provides various options for the treatment of cancer. Because of idiopathic causes cancer is most dangerous health problem and require effective and impactful measures. Thousands of herbal and traditional compounds are being screened worldwide to validate their use as anti-cancerous drugs. *Chemoecostus cuspidatus* has long been used as traditional treatment for diabetes (Remya and Daniel, 2012). 18 million cancer causes around the world in 2018, out of them 9.5 million were man and 8.5 million women suffering with cancer (www.wcrf.org/diet and cancer/cancer-trends/worldwide-cancer-data). Initial screening for *Chemoecostus cuspidatus* carried out by Siqueira, E.P. *et al*., for cancer. Various extracts of rhizomes were used on 6 various cancer cell lines (Jurkat HL 60, THP-1, MCF-7, MDA-MB231 and HCT-116) for *in-vitro* screening. MDA-MB231, MCF-7 and THP-1 did not show sensitivity for any fraction. HL 60, Jurkat and THP-1 cell lines were more sensitive for *Chemoecostus cuspidatus.* Hexane, Dichloromethane and Chloroform shows 4.7µg/ml, 7.3µg/ml and 6.1µg/ml IC_{50} for HL60 cell lines. Hexane and Dichloromethane shows 2.9 µg/ml and 2.2 µg/ml IC_{50} for Jurkat and 8.3 µg/ml and 7.3 µg/ml for HCT-116 (Siqueira *et al*., 2016).

Phytochemical study

The diverse used of *Chemoecostus cuspidatus* as a traditional drug and its commercialization in current scenario leads scientists to its phytochemical exposure. Numerous of fatty acids and their derivatives were identified during the GC-MS analysis of *Chemoecostus cuspidatus* FDE (Freeze dried extract). The recognised VOC were less than 350 Da. These VOC were responsible for the characteristic fragrance of *Chemoecostus cuspidatus* leaf and its extracts (Tominaga, *et al*., 1998). It was unveiled in another study that methanolic extract was found to contain the highest number of phytochemicals such as carbohydrates, triterpenoids, proteins, alkaloids, tannins, saponins and flavonoids (Jothivel, *et al*., 2007). Screening for phytochemicals of *Chemoecostus cuspidatus* leaves revealed it's richness in protein, iron and various antioxidant constituents such as ascorbic acid, α-tocopherol, β-carotene, terpenoids, steroids and flavonoids (Shankarappa, *et al*., 2011 and Thiruchenduran, *et al*., 2016). HPTLC analysis disclosed that sapogenin extract consist of diosgenin, betasitosterol and other sterols are higher in rhizome of *Costus igneus* than leaf and stem. Similarly the concentration of flavonoids such as quecertin and kaempferol higher in rhizome, when compared to leaf and stem (Kalailingam *et al.*, 2012). In a study carried out by Manjula two phytoconstituents were extracted, lupenol and stigmasterol (Manjula *et al.,* 2012) with mobile phase n-hexane: ethyl acetate (80:20v/v) for lupol and tolune: acetone: acetic acid (8.9:0.9:0.2 v/v/v) for stigmasterol respectively (Manjula *et al*., 2012). Natural Diosgenin extracted from sapogenin extrate, with solvent system n-hexane: ethyle acetate (7:3) (Kalailingam, P., 2014). Insulin like protein was sanctified from acidified ethanolic extrat followed by affinity column chromatography. Molecular weight of protein was found to be 56118 dalton. Two fragments of ILP was found to be GLFAPIVVIAR [MH+(mono)=1155.725] and TCAAFTNEGSLIR [MH+(mono)=1552.779] respectively (Hardikar *et al*., 2016). Major Phytoconstituents identified by as per plant's part were as follows:

Plant part	Chemical constituents (Essential oil)
Leaf	hexadecanoic acid, 9, 12-Octadecadienoic acid, ethyl ester, Tetradecanoic acid, Ethyl Oleate, Oleic acid, Octadecanoic acid, 2-benzenedicarboxylic acid, di-isoooctyl ester, Squalene, Tigogenin gracillin, Sitosterol, D-Gucose
Rhizome	hexadecanoic acid, 9, 12- Octadecadienoic acid, ethyl ester, Tetradecanoic acid, Oleic acid, Octadecanoic acid, 1, 2 benzenedicarboxylic acid, diisoooctyl ester, Diosgenin, betasitosterol and sterol, Kaempferol, prosapenin B of dioscin.
Stem	n-hexadecanoic acid, 1, 6-Octadiene 5, 7 acid, Di-n-octyl phthalate.
Seeds	Dioscin, prosapogenis A and B of dioscin, protodioscin, methyl protodioscin gracillin.

Various fatty acids found in *Chemoecostus cuspidatus* were depicted in table 3.

Other Use

The enomerous knowledge of medicinal herbs leads human for healthy life. Commercial application is a valuable approach that uses data to derive information about a particular industry or technology for use in forecasting. Among existing patents to *Chemoecostus cuspidatus*, the majority of them are for synthesis of nano particles for treatment of various ailments including, gold nanoparticles for Diabetes, antifungal and antibacterial activity (Velumani, 2015), ZnO nano particles for antimicrobial activity with pathogenic bacteria (Nandhini, 2018). In the food industry, it has been incorporated into products such as tea.

(Thiruchenduran, 2016), several other small studies also carried out for various preparation of food like Parota, chutney, Khichdi, cutlet and vada (Meti, 2018). One patent for Pharmaceutical Compositions Comprising Costus Igneus Extract filled by Murthy *et al.*, in 2012 (Murthy *et al*., 2012). These patents have demonstrated the high commercial value of *Chemoecostus cuspidatus* and its variety of uses in a number of industries.

Conclusion

Chemoecostus cuspidatus offers various prospects for both Traditional and modern medicines. So far with negligible side effects *Chemoecostus cuspidatus* have been reported with no toxicity. Efforts required for further studies, especially in evaluation of biological activities. Especially evaluating its biological activities *in-vivo* and toxicological and mutagenic properties in order to ratify the safety in biological use of these plants. In all probability there is a need for more preclinical and clinical trials to establish the efficacy of using *Chemoecostus cuspidatus*. Due to effective diabetes management the demand on national and international forum is constantly on the rise. So there is a need to conserve this species and explore its biological uses for more impactful and worthy results.

References

Akhtar and Dhillon (2017). Prevalence and risk factors of diabetes mellitus in India, *Journal of Social Health and Diabetes*, **5(1):** 29-36.

Afsar, B., M.C. Kiremit and A.A. Sag *et al*., (2016). e role of sodium intake in nephrolithiasis: epidemiology, pathogenesis and future directions. *European Journal of Internal Medicine*., **35:** 16-19.

Arun, N., A. Udhaya and P. Rajagaru (2011). *In-vitro* root induction and studies on antibacterial activity of root 3 extract of Costus igneus on clinically important human pathogens. *Journal of Microbiology and Biotechnology research*., **1(4):** 67-76.

Bhat, V., N. Asuti, A. Kamat, M.S. Sikarwar and M.B. Patil (2010). Antidiabetic activity of insulin plant (Costus igneus) leaf extract in diabetic rats. *J. Pharm. Res.*, **3:** 608-11.

Chacko, N., C.S. Shastry, P. Shetty, P. Shyamma, U. D-souza and P. Maulika (2012). Anti hyperlipidemic activity of Costus igneus in Triton X-100 induced hyperlipidemic rats. *International Journal of Pharmaceutical and Chemical Sciences*., **1:** 813-8.

Cornejo-García, J.A., J.R. Perkins, R. Jurado-Escobar, E. García-Martín, J.A. Agúndez, E. Viguera and N. Blanca-López (2016). *Pharmacogenomics of Prostaglandin and Leukotriene Receptors. Frontiers in Pharmacology*, 7.doi:10.3389/fphar.2016.00316.

Devi, V.D. and A. Urooj (2011). Evaluation of anti hyperglycemic and anti lipid peroxidative effect of *Costus igneus* Nak in streptozotocin induced diabetic rats. *International Journal of Current Research*., **33:** 4-8.

Dhondup, T., W. Kittanamongkolchai, L.E. Vaughan, R.A. Mehta, J.K. Chhina, F.T. Enders and A.D. Rule (2018). *Risk of ESRD and Mortality in Kidney and Bladder Stone Formers. American Journal of Kidney Diseases.* doi:10.1053/j.ajkd.2018.06.012.

Emami, S.A., A. Sahebkar and B. Javadi (2016). Paresthesia: A Review of its definition, etiology and treatments in view of the traditional medicine. *Curr. Pharm. Des*., **22:** 321-7.

Evan, A.P. (2010). Physiopathology and Etiology of stone formation in the kidney and the urinary tract. *Pediatric Nephrology*., **25(5):** 831-841.

Giuliani, C., I. Bucci and G. Napolitano (2018). *The Role of the Transcription Factor Nuclear Factor-kappa B in Thyroid Autoimmunity and Cancer. Frontiers in Endocrinology*, 9.doi:10.3389/fendo.2018.00471.

Gullick, N.J. and D.L. Scott (2011). Co-morbidities in established rheumatoid arthritis. *Best. Pract. Res. Clin. Rheumatol.*, **25(4):** 469-483.

Hardikar, M.R., M.E. Varma, A.A. Kulkarni, P.P. Kulkarni and B.N. Joshi (2016). *Elucidation of hypoglycemic action and toxicity studies of insulin-like protein from Costus igneus. Phytochemistry.*, **124:** 99-107.doi:10.1016/j.phytochem. 2016.02.001.

Jothivel, N., S.P. Ponnusamy, M. Appachi, S. Singaravel, D. Rasilingam, K. Deivasigamani and S. Thangavel (2007). Antidiabetic activity of methanol leaf extract of *Costus pictus* D. Don in alloxan induced diabetic rats. *Journal of Health Science.*, **53:** 655-63.

Kala, S. (2014). Antimicrobial Activity of Coleus For skohlii (Wild) Briq and Costus Igneus N.E.Br. IOSR *Journal of Pharmacy and Biological Sciences*., **9(5): Ver. V (Sep - Oct. 2014),** 01-06.

Kalailingam, P., A.D. Sekar, J.S. Samuel, P. Gandhirajan, Y. Govindaraju and M. Kesavan (2011). The efficacy of Costus igneus rhizome on carbohydrate metabolic, hepatoproductive and antioxidative enzymes in steptozotocin-induced diabetic rats. *Journal of Health Science*., **57:** 37-46.

Kesavan, M., R. Kaliaperumal, E. Tamilmani and K. Shanmugam (2012). *In vitro* evaluation of calcium oxalate monohydrate crystals influenced by *Costus igneus* aqueous extract. *Scandinavian Journal of Urology and Nephrology.*, **46(4):** 290-297.

Khanday,W.I., N.A. Wani and B. Paulraj (2019). Antidiabetic Potential of *Costus igneus* Leaf In Streptozotocin Induced Diabetic Wistar Albino Rats. *Journal of Experimental Biology and Agricultural Sciences.*, February - 2019; **7(1):** 65-73.

Krishnan, K., N.R. Vijayalakshmi and A. Helen (2011) Anti-inflammatory potential of β-amyrin, a triterpenoid isolated from Costus igneus. *Inflammopharmacology. Dec*., **22(6):** 373-85. doi: 10.1007/s10787-014-0218-8.

Krishnan, K., N.R. Vijayalakshmi and A. Helen (2014). Beneficial effects of Costus igneus and dose response studies in streptozotocin induced diabetic rats. *International Journal of Current Pharmaceutical Research*., **3:** 42-6.

Kumudhavalli, M.V. and B. Jaykar (2012). Evaluation of Antidiabetic activity of *Costus igneus* (L.) leaves on STZ induced diabetic rats. *Der. Pharmacia. Sinica.*, **3(1):** 1-4. January 2012.

Linlin, Chen, Huidan, Deng, Hengmin, Cui, Jing, Fang, Zhicai, Zuo1, Junliang, Deng, Yinglun, Li1, Xun, Wang and Ling, Zhao (2018). Inflammatory responses and inflammation-associated diseases in organs. *Oncotarget.*, **9(6):** 7204-7218.

Liu, Y., Y. Chen, B. Liao, D. Luo, K. Wang, H. Li and G. Zeng (2018). *Epidemiology of urolithiasis in Asia. Asian Journal of Urology.*doi:10.1016/j.ajur.2018.08.007.

Mani, P., A.R. Kumar, T.M. Bastin, S. Jenifer and M. Arumugam (2010). Comparative evaluation of extracts of COSTUS igneus (or COSTUS pictus) for hypoglycemic and hypolipidemic activity in alloxan diabetic rats. Int. J. Pharm. Tech., **2:** 183-95.

Manjula, K., K. Rajendran, T. Eevera and S. Kumaran (2012). *Effect of Costus igneus stem extract on calcium oxalate urolithiasis in albino rats. Urological Research.*, **40(5):** 499-510. doi:10.1007/s00240-012-0462-6.

Mikawlrawng, K., S. Kumar and R. Vandana (2014). Current scenario of urolithiasis and the use of medicinal plants as antiurolithiatic agents in Manipur (North East India): a review. *International J. of Herbal Medicine*., **2(1):** 1-12.

Ndrepepa, G. (2018). *Uric acid and cardiovascular disease. Clinica Chimica Acta.*, **484:** 150-163. doi:10.1016/j.cca.2018.05.046.

Kalailingam, Pazhanichamy, Kaliaperumal, Rajendra, Tamilmani and Eevera (2011). Efficacy of Methanolic Extract of Costus Igneus Rhizome on Hypoglycemic, Hypolipidimic Activity in Streptozotocin (STZ) Diabetic Rats and HPTLC Analysis of Its Active Constituents. *International Conference on Bioscience, Biochemistry and Bioinformatics. I.P.C.B.E.E.*, **5**.

Raajshree, Khoushika and P. Chitra (2016). A comparative study on the *in-vitro* Anti-Inflammatory and Antibacterial Activities in the leaf extracts of Costus igneus and Mangifera indica. *International Journal of Current Research.*, **8(08):** 36714-36722.

Ramya, Urs S.K. and Jyoti Bala Chauhan (2015). Phytochemical Screening, Antimicrobial Activity and Antioxidant Activity of Costus igneus. *European Journal of Molecular Biology and Biochemistry*., **2:** 93-96.

Rao, N.B., R.G. Gajula, E. Sujatha and O. Sita Kumari (2016). Phytochemical Analysis And Anti-Microbial Activity Of *Costus igneus* (Insulin Plant) Leaf Extract. *I.J.B.P.A.S.*, June, 2016, **5(6):** 1207-1214.

Remya, R and M. Daniel (2012). Phytochemical and pharmacognostic investigation of antidiabetic Costus pictus. D. Don. *Int. J. Pharm. Biomed. Res*., **3:** 30-9.

Sarvanan, A., S. Karunakaran, P. Vivek and S. Dhanasekaran (2014). Studies On Antibacterial Activity Of Root Extract Of Costus Igneus. *International Journal of ChemTech Research*., September 2014. **6(9):** 4201-4206.

Sardessai, Y., Gauri Pai Angle, Arun Joshi, Sonia Carvalho and Maya bhobe (2014). Antimicrobial Activity of Methanolic Extract of the Rhizomes of Costus igneus. *Journal of Pharmaceutical, Chemical and Biological Sciences*., September-November 2014; **2(3):** 176-185.

Shankarappa, L., B. Gopalakrishna, N.R. Jagadish and G.S. Siddalingappa (2011). Pharmacognostic and phytochemical analysis of *Costus ignitius. Internationale Pharmaceutica Sciencia.*, **1:** 36-41.

Shetty, A.J., D. Choudhury, V.N. Rejeesh, V. Nair, M. Kuruvilla and S. Kotian (2010). Effect of the insulin plant (*Costus igneus*) leaves on dexamethasone-induced hyperglycemia. *Int. J. Ayurveda. Res*., **1:** 100-2. HYPERLINK "http://www.ncbi.nlm.nih.gov/pubmed/?term=Chou dhury% 20D%5Bauth%5D". (PubMed).

Shivaprakash, G., D. Elizabeth, S. Rai, Nandini Nischal, K. Reshma, Fahim, Natesh and Pallavi (2014). Evaluation of Antioxidant potential of Costus igneus in ethanol induced peroxidative damage in albino rats. *Journal of Applied Pharmaceutical Science*., August 2014, **4:** 052-055.

Singh, V.K. and P.K. Rai (2014). *Kidney stone analysis techniques and the role of major and trace elements on their pathogenesis: a review. Biophysical Reviews.*, **6(3-4):** 291-310. doi:10.1007/s12551-014-0144-4.

Elavarasi, S. and K. Saravanan (2012). Ethnobotanical Study OF Plants used to treat Diabetes by Tribal People of Kolli Hills, Namakkal District,Tamilnadu, Southern India. *International Journal of PharmTech Research*., Jan-Mar 2012. **4(1):** 404-411.

Shih, R.-H., C.-Y. Wang and C.-M. Yang (2015). *NF-kappaB Signaling Pathways in Neurological Inflammation: A Mini Review. Frontiers in Molecular Neuroscience.*, **8**. doi:10.3389/fnmol.2015.00077.

Sigurjonsdottir, V.K., H.L. Runolfsdottir and O.S. Indridason (2015). Impact of nephrolithiasis on kidney function. *BMC Nephrology*., **16(1):** 149.

Siqueira, E.P., J.P. Ramos, C.L. Zani, A.C.O. Nogueira, D.L. Nelson *et al*., (2016). *Chamaecostus subsessilis* and *Chamaecostus cuspidatus* (Nees & Mart) C.Specht and D.W. Stev as Potential Sources of Anticancer Agents. *Nat. Prod. Chem. Res.*, **4:** 204. doi:10.4172/2329-6836.1000204.

Specht, C.D. and D.W. Stevenson (2006). *A New Phylogeny-Based Generic Classification of Costaceae (Zingiberales). Taxon.*, **55(1):** 153. doi:10.2307/25065537.

Thirumalai, T., C.D. Beverly, K. Sathiyaraj, B. Senthilkumar and E. David (2012). *Ethnobotanical Study of Anti-diabetic medicinal plants used by the local people in Javadhu hills Tamilnadu, India. Asian Pacific Journal of Tropical Biomedicine.*, **2(2):** S910-S913. doi:10.1016/s2221-1691 (12)60335-9.

Tilahun, Alelign and Petros Beyene (2018). Kidney Stone Disease: An Update on Current Concepts. Hindawi Advances in Urology, Volume 2018, Article ID 3068365, 12 pages https://doi.org/10.1155/2018/3068365.

Ting, Liu, Lingyun, Zhang, Donghyun, Joo and Shao-Cong (2017). Sun. NF-κB signaling in inflammation. *Signal Transduct Target Ther.*, **2:** 17023. 2017 Jul 14. doi: 10.1038/ sigtrans.2017.23.

Tominaga, T., M. Murat and D. Dubourdieu (1998). Development of a method for analyzing the volatile thiols involved in the characteristic aroma of wines made from *Vitis vinifera* L. Cv.

Thiruchenduran, S., K.U. Maheswari, J.W. Suneetha, T.N.V.K.V. Prasad and B. Rajeswari (2016). Screening for Plant Secondary Metabolites in Selected Indigenous Herbal Plants. *Imperial Journal of Interdisciplinary Research.*, **2(4):** 1103-1106.

Unnikrishnan, R., R.M. Anjana and V. Mohan (2016). *Diabetes mellitus and its complications in India. Nature Reviews Endocrinology.*, **12(6):** 357-370. doi:10.1038/nrendo. 2016.53.

Vasantharaj, S., S. Sathiyavimal and N. Hemashenpagam (2013). Antimicrobial Potential And Screening Of Antimicrobial Compounds Of *Costus Igneus* Using GC-MS. *International Journal of Pharmaceutical Sciences and research.*, **4**.

World Health Organization (2018). Global Health Observatory Data Repository, http://www.who.int/diabetes/en/,2018.