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Costus speciosus (Keukand): A review

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ABSTRACT

Costus speciosus Koen. (Keu, Crape ginger), an Indian ornamental plant, has long been medicinally used in traditional systems of medicine. The plant has been found to possess diverse number of pharmacological activities. The present article gives an account of updated information on its phytochemical and pharmacological properties. The review reveals that wide numbers of phytochemical constituents have been isolated from the plant which possesses activities like be bitter, astringent, aphrodisiac, purgative, anthelmintic, depurative, febrifuge and expectorant. Rhizomes are given in pneumonia, rheumatism, dropsy, urinary diseases, jaundice while leaves are given in mental disorders. Bruised leaves are applied in fever; decoction of stem is used in fever and dysentery. Various other activities are also reported like anti-inflammatory, antiarthritic effect and antifungal activities. The plant is also used in gout rheumatism and bronchial asthma. Rhizomes of plant exhibit cardiotonic, hydrochloretic, diuretic and CNS depressant activities. These reports are very encouraging and indicate that the plant should be studied more extensively for its therapeutic effects.

Keywords: *Costus speciosus*, Keu, pharmacological activities, phytochemistry, Diosgenin, traditional uses.

INTRODUCTION

Medicinal plants have been of great importance to the health care needs of individuals and their communities. The use of herbal preparations made from medicinal plants is widespread in developing countries [1]. The healing powers of traditional herbal medicines have been realized since antiquities. About 65% of the world populations have access to local medicinal plant

knowledge system. India is sitting on a gold mine of well-recorded and traditionally well-practiced knowledge of herbal medicine. India has an officially recorded list of 45,000 plant species and estimation put the list of 7500 species of medicinal plants growing in its 16 agroclimatic zones under 63.7 million hectares of forest coverage [2]. With an ever-increasing global inclination towards herbal medicine, there is an obligatory demand for a huge raw material of medicinal plants [3]. Medicinal herbs are moving from fringe to mainstream use with a greater number of people seeking remedies and health approaches free from side effects caused by synthetic chemicals [4].

At the present juncture, the modern conventional health care is burdened with great problems of unsafe medicines, chronic diseases, resistant infections, autoimmune disorders and degenerative disorders of ageing, despite great scientific advantages. The modulation of diseased states by using medicinal plant products as a possible therapeutic measure has become a subject of active scientific investigations in the recent years. The basic concept has, however, existed in the ancient Vedic scripture, the Ayurveda, and has been practiced in the Indian traditional medicine for many centuries [5].

The biological evaluation of plant products on the basis of their use in the traditional herbal system of medicine develops a basic platform for the recent and newer drug discovery methods, development of new drugs from different plant sources. From the innumerable plants being researched since time immemorial, *Costus speciosus* is important one. This plant of Costaceae (Zingiberaceae) family, is commonly known as keukand (hindi), Variegated Crepe Ginger (English). It is an erect, succulent, perennial herb, upto 2.7 meters in height, arising from a horizontal rhizome, found in tropical region of India and also cultivated for ornament. Various medicinal properties are attributed to it, particularly in the treatment of asthma, fungal diseases, rheumatism, diabetes, hepatoprotective disorders [6].

Taxonomic Classification

Kingdom	-	Plantae
Subkingdom	–	Tracheobinota
Super Division	-	Spermatophyta
Division	-	Mangoliophyta
Class	–	Liliopsida
Sub Class	-	Zingiberidae
Order	-	Zingiberales
Family	-	Costaceae
Genus	-	Costus
Species	-	Speciosus

Vernacular names

Assam	Tara
Bengali	Keu, Keumut
English	Spiral flag
Guajarati	Paskarmula, Valakdi
Hindi	Keu, Keukand, Kemuka, Kemua

Kannad	Changalvakostu, Chikke
Malayalam	Channakoova
Marathi	Penva, Pinnha, Kobee, Peva
Tamil	Kostam
Telegu	Kashmeeramu, Cengalvakostu
Sanskrit	Kembuka, Kebuka, Kembu

Geographical Source

The plant is widely distributed in India in the tropical or sub-tropical climate from the sea level to the Himalayas, excluding the arid and semi-arid areas of Punjab, Haryana, Rajasthan, Gujarat and the peninsular India [6]. It is found throughout the country in moist tropical evergreen forests, up to an altitude of 1200 m. It is common along roadsides, streams and in wastelands [7]. It is widely distributed in Assam, Meghalaya, Bihar, Khasi and Jaintia Hills, Uttaranchal, Orissa, MP, North Bengal. The Himachal sub Himalayan tracts and Western Ghats are the ideal places for its collection [8].

Morphology

Costus speciosus Koen. (Keu) is an ornamental, rhizomatous, perennial [8], erect, succulent herb, up to 2.7 m in height, arising from a horizontal rhizome. Rhizomes clothed with sheaths in the lower parts, leafy upwards, leaves elliptic to oblong or oblong-lancoelate, thick, spirally arranged, 15-35 cm X 6-10 cm, silky beneath, with stem clasping sheaths up to 4 cm, flowers large, white, in thick, cone-like terminal spikes, with bright red bracts, lip with yellowish throat; fruits globosely trigonous, red capsules, 2 cm in diameter, seeds black, with white aril [6]. The dried rhizome is curved or somewhat straight, cylindrical, branched piece, 10-30 cm in length and 3-5 cm in diameter in dried condition, upper surface marked with circular nodal scars with remnants of leaf bases, lower and lateral surfaces exhibit small circular scars of roots or few wiry rootlets fracture fibrous and fractured surface is yellowish brown. No characteristic taste or odor [7].

Traditional uses

The rhizomes and roots are ascribed to be bitter [8, 9, 10], astringent [8, 9, 10, 11, 12], acrid, cooling, aphrodisiac [6, 9, 12], purgative [8, 9, 10, 11], anthelmintic [6, 8, 10, 11, 12], depurative [6, 10, 11, 12] febrifuge, expectorant, tonic [6, 8], improves digestion [9] and stimulant [8, 9, 12] herb that clears toxins. Juice of the rhizome is applied to head for cooling and relief from headache [8]. An alkaloid ext. from *Costus speciosus* rhizomes had papaverine-like smooth muscle relaxant, antispasmodic activities in lab. animals [13]. Rhizomes are given in pneumonia, rheumatism, dropsy, urinary diseases, jaundice and leaves are given in mental disorders. Bruised leaves are applied in fever; decoction of stem is used in fever and dysentery [6].

Leaf infusion or decoction is utilized as a sudorific or in a bath for patients with high fever. Rhizome juice is given with sugar internally to treat leprosy, used as antivermin [11] and for abortion [6, 14]. The plant possesses purgative, anti-inflammatory and antiarthritic effect, antifungal[4] activities and is used in gout rheumatism and bronchial asthma [11]. The plant is used internally for eye and ear infections, diarrhoea (sap from leaves, young stems), cold, catarrhal fever, cough, dyspepsia, skin diseases (rhizome) and snake bites [6, 9, 10, 12]. Rhizomes

exhibit cardiotonic, hydrochloretic, diuretic, CNS depressant activities [11, 13], formely used in Malaysia for small pox [9]. Tubers are cooked and made into syrup or preserved which is very wholesome [12].

Phytochemistry

Main constituents who have been discovered so far from various parts of *Costus speciosus* are as follows-

Dasgupta et al. (1970) reported that Diosgenin is the major constituent isolated from *Costus speciosus* [15]. The maximum quantity of diosgenin reorted in the stem is 0.65%, in the leaves 0.37% and in the flowers 1.21% [6]. Other constituents isolated are Tigogenin, dioscin, gracillin β-sitosterol glucoside [7].

The seeds contain 6% of pale yellow sweet smelling fatty oil. The physico-chemical properties of the oil are as follows:

Specific gravity	-	0.9125
Refractive index	-	1.4672
Acid value	-	23.84
Saponification value	-	179.84
Iodine value	-	76.4

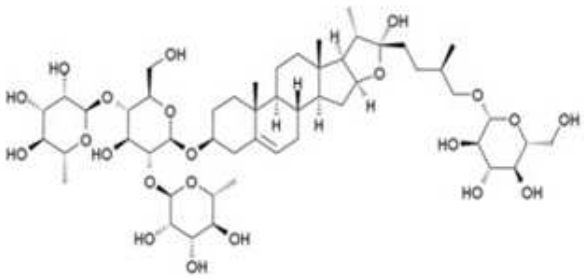
The fatty acid composition of the oil is as follows: Palmitic- 55.97%; stearic- 8.3%; oleic- 22.75%; linoleic- 6.8%; arachidic- 1.7% [6].

Singh et al. (1982) revealed that the saponins from seeds yielded three genins and glucose on acid hydrolysis, major genin was diosgenin. Two new furostanol saponins – costusosides I and J and characterized as 3-O-[β-D-glucopyranosyl(1→4)-β-D-glucopyranosyl]-26-O-(β-D-glucopyranosyl-22α-methoxy (25R) furost-5-en-3β,26-diol and its 22-hydroxy derivatives respectively [16, 17], β-sitosterol-β-D-glucoside, prosapogenins A and B of dioscin, dioscin, gracillin, 3-O-[α-L-rhamnopyranosyl(1→2)-β-D-glucopyranosyl]-26-O-[β-D-glucopyranosyl]-22α-methoxy-(25R) furost-5-en-3β,26-diol,protodioscin and methyl protodioscin were isolated from seeds [16, 18].

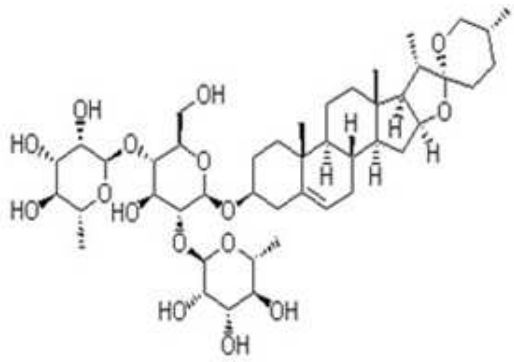
Mehmood et al. (1984) reported that, two new quinones –dihydrophytylplastoquinone and its 6-methyl derivative [19] – along with α-tocopherolquinone and 5α-stigmast-9(11) en-3β-ol are isolated from seeds and their structures were elucidated; methyl hexadecanoate, methyl octadecanoate and tetracosanyl octadecanoate isolated from seeds [20]. A tocopherol is isolated from seeds and identified as G2-tocopherol. Defatted seeds contain Diosgenin, glucose, galactose and rhamnose [21].

Gupta et al. (1981) reported that few constituents were isolated from roots as 24-hydroxytriacontan-26-one and 24-hydroxytriacontan-27-one [22] together with methyl triacontanoate, diosgenin, sitosterol [6, 24], 8-hydroxy triacontane-25-one and methyl triacontanoate [24]. 5α-stigmast-9(11)-en-3β-ol was also characterized [6, 21, 23]. The roots of this plant also contain β-sitosterol-β-D-glucoside, prosapogenins A and B of dioscin, dioscin, gracillin [25], 3-O-[α-L-rhamnopyranosyl(1→2)-β-D-glucopyranosyl]-26-O-[β-D-glucopyranosyl]-22α-methoxy-(25R)furost-5-en-3β,26diol, protodioscin and methyl

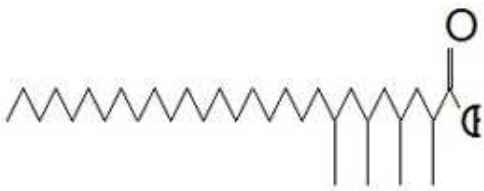
protodioscin. Other components identified were 31-norcycloartanone, cyloartanol, cycloartenol and cycloalaudenol [6, 21].



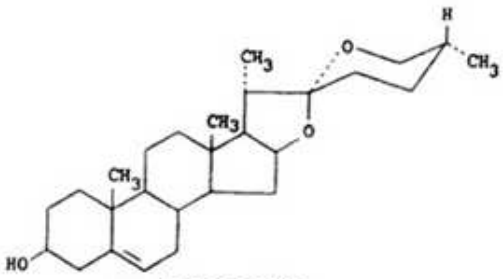
Protodioscin



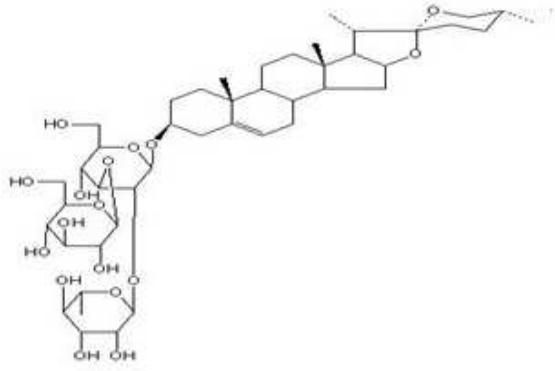
Dioscin



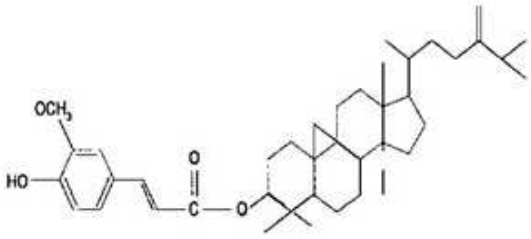
Octasonoic acid



Diosgenin



Gracillin



Cycloartanol

Structures of some phytoconstituents isolated from *Costus speciosus*

Yanyong et al. (1981) revealed that from the petroleum ether extracts of the stems and roots of *C. speciosus*, diosgenin and sitosterol were isolated and identified with authentic samples by comparison of spectroscopic data [26].

Gupta et al. (1986) isolated five new compounds (Oxo acids and branched fatty acids esters) – tetradecyl 13-methylpentadecanoate, tetra 11-methyltriadecanoate, 4-oxotriaconsanoic acid, 14 – oxoheptacosanoic acid and 15-oxooctacosnoic acid from the rhizomes, which were also characterized [27]. Methyl 3-(4-hydroxyphenyl)-2E-propenoate was also isolated from the rhizomes [6, 21]. The rhizomes also contain saponins diosgenin [28], dioscin, gracillin and beta-sitosterol-beta-D-glucoside [11, 29]. The rhizomes yield an essential oil which contains pinocarveol (59.9%), cadinene (22.6%), cineol (10.7%), p-methoxybenzophenone (3.3%) and cavacrol (1.3%) [6]. Bis(2-ethylhexyl)phthalate was isolated from the rhizomes of C. speciosus [30].

Methanolic extracts of underground parts is known to have steroids glycosides: prosapogenin B of dioscin, dioscin, gracillin, methyl protodioscin, methylprotogracillin, protogracillin, 26-O-β-D-glucopyranosyl-(25R)-furost-5-ene-3β,22ζ,26-triol, diosgenin 3-O- β-D-glucopyranosyl(1→3)-β-D-glucopyranoside [31, 32].

Pharmacological actions

Antidiabetic activity & hypolipidemic activity

Diabetes mellitus is a chronic disease characterized by high blood glucose levels due to absolute or relative deficiency of circulating insulin levels [33]. Diabetes mellitus is a chronic metabolic disorder affecting approximately 4% population worldwide and is expected to increase to 5.4% in 2025. Epidemologic studies and clinical trials strongly support the notion that hyperglycemia is the main cause of complications such as coronary artery disease, cerebrovascular disease, renal failure, blindness, limb amputation, neurological complications and premature death [34].

Daisy et al. (2008) investigated the possible protective effects of *Costus speciosus* (Koen.) sm. rhizome extracts on biochemical parameters in streptozotocin (STZ)-induced male diabetic Wistar rats. STZ treatment (50 mg/kg, *i.p.*) caused a hyperglycemic state that led to various physiologic and biochemical alterations. Hexane, ethyl acetate and methanol crude extracts administered at the dose of 250 mg/kg, 400 mg/kg and 400 mg/kg respectively for 60 days to STZ-induced hypoglycemic and normo-glycemic rats. The plasma glucose concentration was significantly ($p < 0.05$) decreased by all three extract compared with controls. The hexane extract of the plant is known to possess antihyperglycemic and hypolipidemic activity is able to ameliorate the diabetic state and is probably a source of hypoglycemic compounds. The hexane crude extract of C. specious rhizome was effective in decreasing the serum glucose level and normalizing other biochemical parameters in diabetic rats [34, 35, 36]. Aqueous extract and methanolic extracts of C. speciosus were highly effective in bringing down the blood glucose level [37].

Bavara et al. (2008) evaluated the antihyperglycemic, antihyperlipemic and antioxidant potency of an ethanol extract of *Costus speciosus* root in alloxan-induced diabetic male (Charles Foster) rats. It is concluded that *Costus speciosus* root extract possesses anti-hyperglycemic,

antihyperlipemic and antioxidative effects, which may prove to be of clinical importance in the management of diabetes and its complications [38].

The effect of freeze-dried rhizome juice of *C. speciosus* on body weight, liver and kidneys of normal and STZ-induced diabetic rats were studied [39].

Anticholinesterase activity

Bhattacharya et al. (1972) confirmed that *C. specious* alkaloids have been shown to possess anticholinesterase activity in both *invitro* and *invivo* methods, explaining the earlier observed potentiation of acetylcholine responses on frog rectus muscle and dog blood pressure. Isolation and selective screening of the individual alkaloids is warranted in order to pinpoint the specific alkaloid or alkaloids responsible for this activity. The use of the plant in eye diseases and as a depurative may be due to the anticholinesterase activity of the plant alkaloids [40].

Hepatoprotective activity

There is a progressive increase in incidence of hepatic damage mainly due to the viral infection, hepatic chemicals (alcohol), and peroxides, toxin in food, pharmaceuticals, environmental pollutants and xenobiotics. There is hardly any remedy available in the modern system of medicine, including corticosteroids and immunosuppressive agents which bring about symptomatic relief supporting only the process of healing or liver regeneration. Hence increasing attention is being given to plant recommended for the treatment of hepatic disorders in the traditional system of medicine [40].

N. Verma, R. L. Khosa. (2009) evaluated the hepatoprotective activity of the ethanolic extract of the rhizomes of *Costus speciosus* (Koenig) Sm. was studied on carbon tetrachloride treated rats. The extract registered a significant fall in the levels of serum glutamyl oxaloacetic acid transaminase (SGOT), serum glutamyl pyruvate transaminase (SGPT), alkaline phosphatase (ALKP), serum bilirubin (SBLN) and liver inflammation supported by histopathological studies on liver, thus exhibited a significant hepatoprotective activity [41].
The ethanolic extracts provide significant protection against the toxic effects of CCL_4 on liver [42].

Antioxidant activity

Vijayalakshmi, N. C. Sarada. (2008) investigated different parts of *Costus speciosus* for their polyphenol content and antioxidant activity [43].
G. S. Chakraborty (2009) showed the antioxidant activity of chloroform extract of *Costus speciosus* leaves for its free radical scavenging activity [44].

Adaptogenic activity

N. Verma, R. L. Khosa. (2009) explained the effect of alcoholic extracts of *Costus speciosus* rhizomes and *Wedelia chinensis* leaves on stress induced changes in brain neurotransmitters and enzyme monoamine oxidase levels in albino rats. The extracts were found to possess normalizing activity against cold immobilization stress induced changes in norepinephrine (NE), dopamine (DA), 5 hydroxy tryptamine (5-HT), 5-hydroxy indole acetic acid (5- HIAA), and enzyme

monoamine oxidase (MAO). The results obtained provide biochemical evidence for antistress activity of the tested extracts [45].

Antibacterial activity

R. B. Malabadi (2005) explained that the hexane, methanol and aqueous extracts of leaf and rhizomes of *C. speciosus* were used by Indian traditional healers for treating skin diseases, diabetes, jaundice, snake bites and/or anti-inflammatory properties and was screened for in vitro antibacterial activities against pathogens isolated from infected burn patients (*Shigella*, *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas, Bacillus subtilis* and *Salmonella*). No antibacterial activity was recorded with water extracts. The disc-diffusion method showed significant zone of lysis against all the pathogens studied [46].

Antifungal activity

U. P. Singh et al. (1992) and B. M. R. Bandara (1998) revealed that the saponins and sapogenins were isolated from *C. speciosus* by column chromatography and their structures were determined by spectral analysis. Antifungal activity of avinocoside-A, tigogenin, saponin B and saponin C were tested on *Alternaria sp., A. tenuissima, Botrytis cinerea, Fusarium lini, Curvularia sp.* and *Sclerotinia sclerotiorum invitro*. Saponin B and avinocoside-A at 2.5 mg/ml were highly effective against conidial germination of *B. cinerea* and *Alternaria sp.*, and *A. tenuissima* and *F. lini*, respectively. It is suggested that these compounds could be used for disease control in the field [47, 48].

Antifertility activity

P. V. Tewari et al. (1973) proved that the saponin mixture showed antifertility activity in rats. A mixture of saponin isolated from the rhizomes of *Costus speciosus* effectively protected against pregnancy in rats, when fed at 5-500 µg/100 g body wt. for 15 days [49].

Oestrogenic activity

S. Singh et al. (1972) explained that saponins showed oestrogenic activity in sprayed rats, significantly increased uterine weight and uterine glycogen concentration and produced proliferative changes in uterus [50, 51]

P. V. Tewari et al. (1973) reported the estrogenic activity of 1600 µg diosgenin (I) [512-04-9] isolated from C. speciosus was approx. equal to that of 150 µg neoclinestrol [52].

Anticariogenic activity

M. Singh et al. (2008) showed that *Costus speciosus* exhibited min. inhibitory conc. ranging from 0.78 to >10 mg/M1 [53].

Spasmolytic activity

R. Banerji et al. (1982) proved that all the extracts exhibited a moderate degree of nonspecific spasmolytic activity when tested on guinea pig ileum, although the activity was weak compared with that of papaverine [54].

Anti-Inflammatory & Antipyretic Properties

K. Binny et al. (2010) reported that rhizome of *Costus speciosus* has been traditionally used for treating inflammatory and painful conditions. The ethanolic extract of the rhizome of *Costus speciosus* possesses anti-inflammatory and antipyretic properties. Anti-inflammatory property was studied in carrageenan induced paw oedema and cotton pellet induced granuloma formation. Significant anti-inflammatory effect was found against carrageenan induced oedema formation in rats at a dose of 800 mg/kg and against cotton pellet granuloma formation in rats at doses of 400 mg/kg and 800 mg/kg. The antipyretic property was studied in yeast-induced pyrexia in rats. The antipyretic effect was only minimal and was observed only at 800 mg/kg dose [55].

CONCLUSION

Medicinal plants have attracted considerable global interest in recent years [56]. In the past few decades pioneer work in identification, documentation and recognition of traditional medicine has been done in India. Investigation of traditional medicine is very important for the welfare of rural and tribal communities for the treatment of conventional illness [57].

From the thorough study and investigation of the available literature of *Costus speciosus* it is clearly shown that the plant serves as an important source of many therapeutically efficient chemicals, like diosgenin, steroidal saponins like prosapogenin, α & β of dioscin, furostanol saponins like Costusoside I & J, octasanoic acid, cycloartenol and various other constituents. Many different pharmacological activities are attributed to it like antidiabetic activity, hypolipidemic activity, hepatoprotective, antifertility, antioxidant activity and antifungal activity. Various traditional uses are also known to be possessed by the plant like in rheumatism, bronchial asthma, leprosy, as cardiotonic and many more. Many activities are not studied till date and needs attention to explore further medicinal properties of the plant. As *Costus speciosus* has been successfully used in many health problems since a long time it provides a wide area of interest for the research purposes in development of newer drug molecules. The therapeutic potential should also be seen in combination with other medicinal agents.

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