

COSTUS SPECIOSUS, AN ANTIDIABETIC PLANT - REVIEW

A. Sabitha Rani[†], G. Sulakshana and Sudeshna Patnaik

ABSTRACT

Costus speciosus (Family: Costaceae) is an important medicinal plant widely used in several indigenous systems of medicine for the treatment of various ailments. The rhizome of these plants are used as an alternative source for diosgenin and generally used to control diabetes. Nurseries are now promoting this exotic species as an 'antidiabetic plant' which lowers the blood sugar levels. Presently these plants are mostly collected from wild habitat only. Due to indiscriminate collection from natural habitat *C. speciosus* has become endangered. To overcome the problem an effort should be made for conservation and systematic cultivation of *C. speciosus*. The present review deals with habit and habitat, cultivation, uses, medicinal properties, future research needs involving *C. speciosus*.

KEYWORDS: Diosgenin, Curcumin, Steroidal Saponins, Spiral Ginger, Insulin.

INTRODUCTION

Higher plants are major sources of therapeutic agents and extensively utilized throughout the world in traditional as well as modern system of medicine. Currently more than 2000 plants are used as single drugs (1000) and compound formulations (8000). [1] In India, the agro-climatic conditions provide an ideal habitat for the growth of more than 9500 medicinal plants. Thus, there is an enormous scope for India to emerge as major player in medicinal plant sector. Plant products contain many important chemicals with medicinal and valuable pharmacological properties. There is a growing demand for natural products of medicinal/pharmaceutical importance in both domestic and international market. The current demand for the plant based products in medicine and industry has resulted in extensive investigation of the plants for potential therapeutic agents. *Costus* Linn. is a tropical herbaceous plant from family Costaceae under the order Zingiberales. The leaves are large and spirally arranged on stems which differentiate it from its nearest relative, the zingiber or true ginger. Hence these plants are often referred as the spiral ginger or Crepe ginger. The *Costus* spp are commonly grown as medicinal and ornamental plants. The rhizome is the major source of diosgenin, which is anti-diabetic in nature and is used in the treatment of diabetes mellitus [2] [3]. The most popular species in the genus is *C. speciosus*, which has emerged as an important antidiabetic plant [4];

DISTRIBUTION

Costus speciosus (Koenig) Sm., is native to the Malay Peninsula of Southeast Asia. In India the plant naturalizes in Sub-Himalayan tract, in parts of central India and in the Western Ghats of Maharashtra, Karnataka and Kerala [5]. There are more than 100 species of the *Costus*. The different species of *Costus* vary in flower colour. Some varieties with flowers and bracts look like compact cones, while others are shaped like pineapple or soft crepe coming out of green cones. Some leaves are pubescent on abaxial surface, while others are smooth and purplish. [6]. About seven species of the genus *Costus* Linn. are known from India. Other cultivated species of this genus are *C. barbatus*, *C. chartaceus*, *C. cuspidatus*, *C. giganteus*, *C. igneus*, *C. osae*, *C. spectabilis*.

CULTIVATION

C. speciosus are usually grown in fertile, organic, moist, well-drained soils in shade [7]. Tropical climate with high humidity and minimum temperature 13° C is best for its cultivation. Crepe ginger grows from thick fleshy roots called "rhizomes". A single rhizome will produce new shoots and increase to a 3 ft wide clump in the second year under ideal growing conditions. *Costus* reproduces vegetatively by rhizomes, division of culms, stem cuttings. It can also be grown through seeds. *Costus* seeds are dispersed by birds when they feed on the fruits. The percentage of seed germination is about 62%. [8]. Standard cultivation practices of *C. speciosus* have yet not been developed.

MORPHOLOGY

C. speciosus is a perennial rhizomatous herb with erect or spreading stems. [9]. Leaves are simple, smooth, persistent, spirally arranged

Department of Botany Osmania University College for Women, Koti, Hyderabad-500095

[†]Corresponding Author: sabitaamma@yahoo. Com

around the trunk. The leaves are sub sessile and appear dark green in colour, elliptic or obovate in shape. The inflorescence is a spike around 10 cms long with large bracts in sub terminal position. Bracts are ovate or mucronate and bright red in colour. Flowers are white in colour, 5-6 cm long with a cup-shaped labellum and crest yellow stamens. Fruit is capsule and red in colour. Seeds are black, five in number with a white fleshy aril [10]. The flowers look like crepe paper, thus commonly called crepe ginger. After the flowers fade away, the attractive red cone-shaped bracts remain. Generally, the stems sprout during the month of April. The flowering appears during middle of the November after which the leaves are shed and majority of canes start drying up. The rhizome remains dormant from December to March or even April [11].

MEDICINAL PROPERTIES

The rhizomes are bitter and show anthelmintic, astringent, expectorant properties. [12] [13] [14]. The rhizome extract is used as tonic and useful in relieving burning sensation, constipation, leprosy, asthma, bronchitis, anaemia and other skin ailments [15]. Rhizomes of *Costus* are used as herbal remedy for fever. The rhizome of *C. speciosus* has hepatoprotective properties [16]. Rhizome paste is used for treating boils and also to make sexual hormones and contraceptives [17]. Leaves are used for scabies and stomach ailments. Stems are ground into paste and applied for blisters. Rhizome extract is used for treating snake bites. [18] [19] [20]. *C. speciosus* is traditionally used as a medicinal herb mainly for its stimulant, carminative, diuretic, digestive and antiseptic properties. The rhizome is used internally in the treatment of abdominal pain, liver problems, jaundice, gall bladder pain etc. The leaves and rhizomes of *C. speciosus* have been reported to possess steroid -diosgenin, which is anti-diabetic in nature. The Leaves also possess hypoglycemic properties and insulin potentiating action in addition to decreasing blood glucose. [21] In Ayurveda, *C. speciosus* is used to subdue *vata* and *kapha* and promotes complexion. It is reported to cure dyspepsia, cough and other respiratory disorders. It is one of the constituent of indigenous drug "*amber mezhugu*" useful in rheumatism [22]. The rhizome possesses antifertility, anticholinesterase, anti-inflammatory, antipyretic and antihelminthic activities [23-25]. Essential oil from rhizome showed antimicrobial activity [26]. Steroid saponins and saponins from *C. speciosus* exhibited antifungal activity [27]. In Southeast Asia it is used to treat boils, constipation, diarrhoea, dizziness, headache, ear, eye, and nose pain, and to stop vomiting. Japanese used the rhizome extract in control of syphilis [28]. Pharmacological studies showed that the rhizomes of *C. speciosus* possess cardiotoxic, hydrochlorotic, diuretic and CNS depressant activity [29].

OTHER USES

In south -East Asia *C. speciosus* are used as a food plant. Tender young shoots, fruits and rhizome are used as vegetables.

CHEMICAL CONSTITUENTS

The rhizomes are the major source of diosgenin. The major chemical constituents are diosgenin, curcumin and curcuminoids. Tubers and roots of *Costus* contain 5 α -stigmasten-3 β -ol, sitosterol- β -D-glucoside, dioscin, prosapogenins A and B of dioscin, gracillin and quinines [30]. Saponins were also reported from rhizomes, including seeds and roots. Saponins

isolated from seeds were reported to possess hypotensive and spasmolytic effect. Tigogenin and diosgenin (2.6%) have been isolated from rhizomes [12]. Various compounds like α -amyrinsterate, β -amyrin and lupeol/Palmitates was isolated from leaves [31]. Two new quinones-dihydrophytylplastoquinone and its 6-methyl derivatives and α -tocopherol isolated from seeds [32]. Five new compounds-tetradecyl 13-methylpentadecanoate, tetradecyl 11-methyltridecanoate, 14-oxotricosanoic acid, 14-oxoheptacosanoic acid and 15-oxooctacosanoic acid- isolated from rhizomes [33]. Seed oil (6.0%) consists of palmitic acid (55.97%), oleic acid (23.75%), linoleic, stearic, myristic and lauric acids. Fatted seeds contained diosgenin, glucose, galactose and rhamnose. From the roots, 31-norcycloartanone, cycloartanol, cycloartenol and cyclolaudenol were isolated [34]. Methyl 3-(4-hydroxyphenyl)-2E propenoate was isolated from rhizomes [35].

BIOTECHNOLOGICAL APPROACHES

Tissue culture techniques are useful for *ex situ* conservation of rare, endemic and threatened plant species. Clonal propagation and *in vitro* multiplication of *Costus* will result in large-scale production of these plants. This will help in supplying uniform planting material for commercial cultivation of this species. Differential diosgenin accumulation in *C. speciosus* and its tissue cultures have been studied [36]. A study on callus cultures from zygotic embryos of *C. speciosus* and their morphogenetic responses was conducted [37]. *C. speciosus* can be successfully micropropagated from pseudostem without any significant damage to the mother plant [38]. Proliferation of shoot tips and Clonal multiplication of *C. speciosus* was conducted [39]. Propagation of *C. speciosus* through *in vitro* rhizome production was studied [40]. High percentage of shoot multiplication was reported by using triacontanol [41]. Thus, there is a need to develop standard methods for the mass propagation of this important plant.

CONCLUSION

India has been projected by WHO as the country with fastest growing population of diabetic patients with estimation of around 3.2 crores by the end of 2010. The use of *C. speciosus* has proved as an alternative source of diosgenin and viable anti-diabetic drug. Presently this plant is having much commercial demand. Thus there is a need for us to conserve and to produce *C. speciosus* on large scale so that we can provide required plant materials for farmers, nurseries and pharmaceutical industries at affordable prices.

REFERENCES

- Rajasekharan, S, Pushpangadan, P and Biju, S.D,1996 .Folk Medicines of Kerala - A Study on Native Traditional Folk Healing Art and its Practitioners in Jain, S.K. (ed) Deep Publications, New Delhi India pp167-172.
- Roy, M.M and Datta, S.C.1977. Investigation of *Costusspeciosus* (Koen) sm.as a source of Diosgenin:Part-I.Indian Drugs, 15:14-16
- Dasgupta, B.and pandey,V.B.1970.A new Indian source of Diosgenin (*Costusspeciosus*)Experimentia ,26:475.
- Bavara G.H, Narasimhacharya A. V. R. L, 2008.Phytotherapy Research, 22(5), 620-626.
- Sarin,Y.K.,Bedi,K.L.andAtal, C.K.1974.*Costus speciosus* Rhizome as source of diosgenin.curr.sci.,43(18):569-570.
- Anonymous 1988. Wealth of India Vol. 2. Publication and information Directorate CSIR. New Delhi.
- Whistler, W.A.2000.Tropical ornamentals: a guide. Timber press, Portland, Oregon.542pp.
- MerinaBenny,2004.Insulin plant in gardens.Natural product radiance,vol3:pp.349-350
- Gupta R.K, 2010. Medicinal and Aromatic Plants, CBS Publishers and Distributors, 234,499.
- Stone and Benjamin C.1970.The flora of Guam.Micronesica 6:1-659.
- Sarin,Y.K.,Singh,A.,Bedi,K.L.,Kapur,S.K.,Kapahi,B.Kand Atal,C.K.1982:*Costus speciosus* rhizomes as a commercial source of diosgenin. In: Cultivation and utilisation of Medicinal Plants,C.K.Atal and B.M.Kapur (eds.), RRL-CSIR, Jammu Tawi,PP.106-118
- Gupta A.K, Tondon N, Sharma M,2008. Quality Standards of Indian Medicinal Plants,Medicinal Plants Unit, Published by Indian Council of Medical Research, Vol VII, 48.
- Bown Deni,2008. Encyclopaedia of Herbs, The Royal Horticulture Society, Page no181.
- Chopra R.N, Nayar S. L, Chopra I. C,2006.Glossary of Indian Medicinal Plants, National

- Sivarajan, V.V. and Balachandran,I.1994.Ayurvedic drugs and their plant sources, Oxford and IBH Publishing Co.pvt Ltd, New Delhi.
- Bhuyan B., Zaman K. 2008. Evaluation of hepatoprotective activity of rhizomes of *Costusspeciosus*(J. Konig.) Smith. Pharmacologyonline; 4 (3): 119-126.
- Warrier, P.K.,Nambiar,V.P.K. and RamanKutty,C.1933-1995.Indian medicinal plants.Vol.1- 5,Orient Longman Ltd., Madras.
- Khanna, P., G. L. Sharma, A. K. Rathore and S. K. Manot (1977). Effect of cholesterol on in vitro suspension tissue cultures of *Costusspeciosus*(Keon.) Sm. *Dioscorea floribunda*, *Solanumaviculare*and *Solanumxanthocarpum*. Ind. J. Exptl. Biol. 15:1025-1027.
- Rathore, A. K. and P. Khanna ,1978. Production of diosgenin from *Costusspeciosus*(Koen.) Sm. and *Solanumnigram*L. suspension cultures. Curr. Sci. 47:870-871.
- Rastogi, R. P. and B. N. Mehrotra ,1991. Compendium of Indian medicinal plants. p.81-84, vol.2 (1970-1979). Lucknow, India: Central Drug Research Institute (CDRI).
- Eliza J, Daisy P, Ignacimuthu S,2008. *Journal of Health Sciences*, 54(6), 675-681
- Chopra,R.N.,Nayer,S.L. andChopra,I.C.1956. Glossary of Indian medicinal plants. CSIR publication and information Directorate. New Delhi .
- Bhattacharya S.K., Parik A.K, Debnath P.K., Pandey V.B., Neogy N.C. 1972. Anticholinesterase activity of *Costusspeciosus*alkaloids. Indian J. Pharmacol; 4: 178-178.
- Binny K, Sunil Kumar G, Dennis Thomas.2010.*Journal of Basic and Clinical Pharmacy*, 1(3), 177- 181.
- Hussain,A.,Virmani,O.P.,Popli,S.p.,Misra,L.N.,Gupta,M.M.,Srivastava,G. N.Abraham,Z.and Singh,A.K.1992.Dictionary of Indian medicinal plants.CIMAP,Lucknow,India,546p.
- Asolkar,L.V.,Kakkar,K .K and Chakre,O.J.1992.Second supplement to Glossary of Indian medicinal plants with active principles. Part I(A-K).(1965-81).Publications and information Directorate(CSIR).New Delhi.414p.
- Singh, U. P. and Srivastava B.P. 1992. Antifungal activity of steroid saponins and sapogenins from *Avenasativa* and *Costusspeciosus*. *Naturalia Rio Claro* 17: 71-77.
- Jain, S.K. 1991. Dictionary of Indian Folk Medicine and Ethno botany. Deep Publications, New Delhi.
- Bhattacharya,S,K A. K. Parikh, P. K. Debnath, V. B. Pandey. N, C.Neogy. 1973.*Journal of Research in Indian Medicine*,8(1), 10-19.
- Mahato, S.B., Sahu, N.P. and Ganguly, A.N.1980. Carbon-13 NMR Spectra of Dioscin and Gracillin isolated from *Costusspeciosus*, Indian J.Chem., 19B:817-819
- Pai,P.P.; Kulkarni,G.H.1997.Isolation of α -amyrinsterate, β -amyrin and lupeolpalmitates from the *Costus* leaves,Curr.Sci,46,261-62.
- Mahmood U., YogendraShukla N. and Raghunath Thakur S., 1984: Benzoquinones from *Costusspeciosus* seeds, phytochemistry vol.23,1725-1727.Vol. 4: 224.
- MadanGupta M., Ram LalN.andYogendraShukla N. 1981.5 α -stigmast -9(11)-en-3 β -ol,a sterol from *Costusspeciosus*roots,Phytochemistry vol.20,1981 page 2257-2259.
- Rastogi, R.P., Mehrotra B.N, 1999. Compendium of Indian medicinalplants.CDRI,Lucknow and Institute of Science Communication, New Delhi. Vol. 2: 215. Vol. 3: 204.
- Rai, M. K., Pandey, A. K. and D. Acharya 2000.Ethno-medicinal Plants Used by Gond Tribe of Bhanadehi, District Chhindwara, Madhya Pradesh. *Journal of non-timber forest*, 7(3/4): 237-241.
- Indrayanto, G., B. Setiawan.1994. Differential diosgenin accumulation in *Costusspeciosus* and its tissue cultures. *PlantaMedica* 60(5): 483-484.
- Roy, A. and Pal, A.1995.Callus cultures from Zygotic embryos of *Costusspeciosus* and their morphogenetic responses J. Plant Biochem. Biotechnol,4(1):29-32.
- Philip Robinson,J, John Britto. S and Balakrishnsn.V2009 Micropropagation of *Costusspeciosus* (Koem.ex.retz) Sm., an Antidiabetic Plant by Using Explants of Pseudostems . Botany Research International 2 (3): 182-185.
- Chaturvedi,C.,Misra,P.and Jain,M.1984. Proliferation of shoot tips and clonal multiplication of *costusspeciosus* in long term culture. *Plant sci Lett*,35,67-71.
- Roy, A. and Pal ,A.1991. Propagation of *Costusspeciosus* (Koen). Sm. through in vitro rhizome production. *Plant Cell Reports* 10(10): 525-528.
- Malabadi, R.B.,Mulgund, G.S. and Nataraja. K.2005.Effect of Triacontanol on the micropropagation of *Costusspeciosus* (Koen.) sm. using rhizome thin sections. *In vitro cell. Dev.Biol-plant*,41,129-132.