



International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR | Volume 4 | Issue 3 | July - Sep - 2016
www.ijamscr.com

Review article

Medical research

A review on antidiabetic property of *Costus Speciosus* (Kemuka)

¹Jyotirmay Choudhury, ²Bishnu Prasad Sarma

¹PhD Scholar, SSUHS, Assam.

²Professor & HOD Dept. of Kayachikitsa, Govt. Ayurvedic College Guwahati, Dean, Faculty of Ayurveda, SSUHS, Assam

*Corresponding Author: Jyotirmay Choudhury

ABSTRACT

Medicinal plants have great importance in primary health care needs mankind and around 80% of world population relies on traditional medicinal system. India rich in herbal resources and Kemuka (*Costus speciosus*) is one of the important medicinal plants used in treatment of different diseases along with diabetes. This erect, succulent, perennial herb is native to South East Asia, especially found in India, Srilanka, Indonesia and Malaysia. The plant is described as Pramehaghna in Ayurveda and traditionally used by local people in different parts of Assam, Darjeeling, and Kerala for the treatment of diabetes. Various experimental studies around the world have explained its antidiabetic properties.

Keywords: Antidiabetic, Herbs, *Costus speciosus*, Kemuka, Ayurveda

INTRODUCTION

Medicinal plants have been of great importance in human culture to meet the primary health care needs. Many people in developing countries use medicinal plants as traditional drugs. According to world health organization up to 80% of world population relies of traditional medicinal system for some aspect of primary health care [1]. India is rich in indigenous herbal resources consist of near about 20,000 plant species, of which about 2,500 are of medicinal value [2] The herb 'Kemuka' or 'Kebuka' (*Costus speciosus*) have wide range of pharmacological action including antidiabetic activity which is also mentioned in the Ayurvedic text and have the reference of traditional use. Different experimental studies have been done on antidiabetic property of this plant.

Scientific name: *Costus speciosus* (Koen) Sm.

Classification

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Liliopsida – Monocotyledons
Subclass: Zingiberidae
Order: Zingiberales
Family: Costaceae – Costus family
Genus: *Costus* L. – costus
Species: *Costus speciosus* (J. Koenig) Sm. – canereed [3]
Sanskrit synonyms: Kemuka, Kebuka, Kustha, Kembuk, Ruk, Phalaka, Kashmeeraja, Vashya. [4]

Vernacular names

Malaysia – Setawar, Hutan, Tawar-tawar, Teng;
Indonesia – Tabar-tabar (Batak), Kalacim

(Bangka), Sitawar (Minangkabau), Pacing Tawar (Sunda) Tepu Tawa (Bugis); Thailand – Kustha, Ueang Phet Maa; Vietnam – Cat loi, Cay Cu Choc, Cu Choc, Mia Do; Nepal – Kusth; China – Bi-qiao-jiang; Hongkong – Bight-sour, Gueng ; Japan – O-hozaki-ayame; [5]English- Spiral flag. [6]

Vernacular names in different parts of India are - Assamese- Kebuk, Devitokan. jom lakhuti [7]; Hindi- Keu, Kemuka, Kemua, Kevuka, Kobee, Kust [8]; Bengali- Kou, Kust, Kemat, Keugachh; Marathi- Penva, Pinnga, Kobee, Pinga, Pushkarmula [9]; Malayalam- Channak-koova. Narum canna, Cannakkuvva, Cannukkilannu [9]; Talegu- Kashmeeramu, kasmiramu, kevukinna, kimuka, koshtamu, bhangalkoshta, bommakaccika [10]; Kannada- Aarathi kundige, Benne kundige, Cangalakoshta, [10]; Pharasi- Kalaam; Tamil- Kostam [7] cancamancam, catikostam [10]; Gujrati- Pakarmula [8]

Background of the plant in diabetes mellitus

- The plant Kemuk (*Costus speciosus*) is described as Pramehaghna in Bhabaprakash Nighantu under Shakavarga. [11]
- Charaka has mentioned it in Tiktaskandha and in Shakavarga.[12]
- Sushrut and Bagbhata have also mentioned Kemuka in Shakavarga. Moreover Bagbhata has mentioned the use of its rhizome in obesity.[13, 14]
- The plant *Costus speciosus* is traditionally used by local people in different parts of Assam for the treatment of diabetes.
- *Costus speciosus* rhizome decoction is used by the tribes of Darjeeling and Sikkim hills. [15]
- The fresh juice of the plant leaf and rhizome is use in Kerala [16] and Bengal region respectively for treatment of diabetes.

Botanical description

It is an erect, succulent, perennial herb, up to 2.7 meters in height, arising from a horizontal rhizome. Rhizomes clothed with sheaths in lower parts, leafy upwards, leaves elliptic to oblong or oblong lanceolate, thick, spirally arranged 15-35 cm X 6-10 cm, silky beneath, with stem clasping sheaths up to 4 cm, flowers bisexual, [6] large, white, in thick, cone like terminal spikes with bright red bracts, lip with yellowish throat; fruits globose trigonous, red capsules, 2 cm in diameter, seeds black, with white aril. [17]

Flowering and fruiting time is usually July to February. [6]

Characters of rhizomes

The rhizomes are tuberous having length from 10-30 cm and diameter from 1.5-3.5 cm, are usually un-branched sub-cylindrical and are covered by a brownish epidermis or cork. At intervals on the upper and lower surface, small circular scars 4-6 mm in diameter are found.

Distribution

Costus speciosus is native to South East Asia, especially found in India, Srilanka, Indonesia and Malaysia, but it has been naturalized in some tropical areas of the rest of the world like Hawaii. 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. It is found throughout the country in moist tropical evergreen forests, up to an altitude of 1200 m, common along roadsides, streams and in wastelands It is widely distributed in Kerala, Tamil Nadu, Assam, Meghalaya, Bihar, Khasi and Jaintia Hills, Uttaranchal, Orissa, MP, North Bengal while the Himachal sub Himalayan tracts and Western Ghats. [18] Within India it is commonly found throughout up to an altitude of 1800 m, in the moist, shady localities under the deciduous forests; also cultivated for ornament. [10]

Chemical composition

The rhizomes of *Costus speciosus* are the major source of diosgenin. The other major chemical constituents are curcumin and curcuminoids, tuners and roots contain 5 α -stigmasten-3 β -ol, sitosterol- β -D-glucoside, dioscin, prosapogenins A and B of dioscin, gracillin and quinines. Saponins were also reported from rhizomes, including seeds and roots. Tigogenin and diosgenin (2.6%) have been isolated from rhizomes. Various compounds like α -amyrinsterate, β -amyrin and lupeol Palmitates was isolated from leaves. Two new quinones – dihydrophytylplastoquinone abd its 6-methyl derivatives and α -tocopherol isolated from seeds. Five new compounds - tetradecyl 13-methylpentadecanoate, tetradecyl 11-methyltridecanoate, 14-oxotricosanoic acid and 15-oxotricosanoic acid are isolated from rhizomes.

From the roots 31-norcycloartanone, cycloartanol, cycloartenol and cyclolaudenol were isolated, Methyl 3-(4-hydroxyphenyl)-2E propentone was isolated from rhizomes. [19]

Properties

According to Ayurvedic classics the *Costus speciosus* qualities (Guna-karma) are- Rasa- tikta, kasaya; Guna- laghu, ruksha; Vipak- Katu; Virya-Sheeta; Prabhava- Garbhasaya samkochak (uterine contractor); Dosa karma- Kapha-Pitta shamak & Vata vardhak. [4]

Pharmacological properties

Costus speciosus shows Antidiabetic activity & hypolipidemic activity [20] [21] [22] [23], Hepatoprotective activity [24] [25], Anticholinesterase activity [26], Antibacterial activity [27], Antifungal activity [28], Adoptogenic activity [29], Antioxidant activity [30] [31], Anti-Inflammatory & Antipyretic Properties [32], Anthelmintic activity [33], Oestrogenic activity [34] [35], CNS depressant, Antiviral [6] Antigenotoxic, and anti-histopathologic activity [36], Anticariogenic activity [37], Antifertility activity [38].

Animal experiment of *C. speciosus* for Hypoglycemic activity:

In animal experiment of *Costus speciosus* rhizome juice on model rats of both IDDM & NIDDM shows that, *C. speciosus* had no effect on post prandial glucose level when fed simultaneously with glucose in non-diabetic rats. When fed 30 minutes before oral glucose load it showed significant result against control group, $p < 0.05$ at 60 minute. In NIDDM model rats, when fed simultaneously with glucose it had no effect. In IDDM model rats it shows no effect in fasting state, but in post prandial state when *C. speciosus* fed simultaneously with glucose load, it significantly opposed the rise of glucose level ($p < 0.002$). *C. speciosus* shows no significant effect on post prandial serum glucose when fed 30 minutes before glucose load. This research was done by Mosihuzzaman et al at BIRDEM, Dhaka.

In this study *Costus speciosus* was effective in non-diabetic as well as diabetic model rats (both groups). However the action is more similar in non diabetic and NIDDM model rats compared to IDDM model rats. Effectiveness in only post

prandial state when fed 30 minutes before glucose load indicates more towards a systemic action and also include the possibility of inhibition of gastric emptying and involvement of gut hormones. In contrast to the effects on non diabetic and NIDDM model rats, when fed simultaneously or 30 minutes before glucose load, among various possibilities, two groups of agents; one acting through stimulation of insulin secretion from islets and other acting either at the gut level or at the peripheral tissues may be conceived. Analysis of the nature of the action of the plant in IDDM model rats indicates its effect at the glycogen synthesis level, since glycogenesis is the predominant mechanism at fed state in contrast to gluconeogenesis which is characteristically activated at fasting state in diabetic animals. [21]

In the experimental study done by P Daisy, streptozotocin induced diabetic rates are treated with Hexane, ethyle acetate and methanol extracts of *C. speciosus*. After 60 days of administration the plasma glucose concentration was significantly ($p < 0.05$) decreased by all three extracts compared with controls. In addition oral administration of hexane extracts significantly decreased glycosylated Hb, serum total cholesterol, and triglyceride levels, urea, uric acid, and creatinine and at the same time markedly increased plasma insulin, tissue glycogen, serum protein, and HDL level. This study shows that the *C. speciosus* hexane extracts has antihyperglycemic and hypolipidemic activity, and probably a source of oral hypoglycemic compound.

This study suggests, the hypoglycemic effects of *Costus speciosus* may result from the potentiation of insulin from existing beta cells of the islets of Langerhans. The decrease in body weight of diabetic rats is possibly due to decreased catabolism of fats and protein content in muscle tissue by proteolysis. Significant decrease in HbA1c suggests that overall blood glucose control is improved due to improvement of insulin secretion. Increase of skeletal muscle and liver glycogen is due to stimulation of insulin release from beta cells. [22]

In another experimental study by J Bavarva, antihyperglycemic, antihyperlipidemic and antioxidant potency of ethanol extract of *Costus speciosus* root was studied in alloxan-induced diabetic rats. Four groups of diabetic rats were administered orally with different doses of *C.*

speciosus extracts (150, 300 and 450 mg/kg BW) and one with glibenclamide (600 microg/kg BW) for 4 weeks. Further two groups served as normal and diabetic controls. While the control showed significant abnormal carbohydrate, lipid and antioxidant profiles, the administration group with dose of 150 mg/kg BW neither improved glucose nor lipid metabolism and antioxidant level. However, other two groups with dose of 300 and 450 mg/kg BW shows a reversal of diabetes and its complications with significant lowering of blood glucose concentration (26.76%, 34.68%), increased glycogenesis and decrease glyconeogenesis. There is also reduction of plasma total lipid (12.87%, 178.24%), cholesterol (21.92%, 30.77%) and triglyceride (25.32%, 33.99%) and improvement of hepatic antioxidant enzyme activities. [20]

MS Rajesh et.al, in their study anti hyperglycemic activity of petroleum ether, chloroform, methanol and aqueous extracts of *C. speciosus* rhizomes studied on overnight fasted, streptozotocin induced diabetic rats. Blood glucose monitored at 0, 30, 60, 120, 240 minutes suggested significant reduction by the extracts of *C. speciosus* except the petroleum ether extract. Aqueous and methanol extracts reduced initial blood glucose level of 387 to 120 mg/dl and 303 to 161 mg/dl respectively at the end of 240 minutes. The similar study on the oral glucose tolerance test (OGTT) also suggested that the aqueous and methanol extracts of *C. speciosus* were highly effective in bringing down blood glucose level 590 to 96 mg/dl

and 570 to 128 mg/dl respectively at the end of 240 minutes. [23]

DISCUSSION

The plant Kemuk (*Costus speciosus*) is available in South East Asia and widely distributed in India. The plant is described in Ayurvedic texts and also mentioned its antidiabetic property. This erect, succulent, perennial herb is also traditionally used for treatment of diabetes and other diseases. In different tradition and places its different parts are used for treatment. Ayurveda described rhizome part to be used which is a major source of diosgenin. The qualities of *Costus speciosus* like-tikta, kasaya Rasa; laghu, ruksha in Guna; Kapha-Pitta shamak & Vata vardhak as described in Ayurveda are opposite to the character of Kapha and Meda which are the main vitiated factors for diabetes. Experimental studies have showed its hypoglycemic action along with hypolipidemic action which strengthens the vast possibility of the herb for treatment of diabetes mellitus.

CONCLUSION

Costus speciosus (Kemuka) which is easily available in India, with its reference of traditional uses and proven hypoglycemic, hypolipidemic activity in recent experimental research outcome suggest its tremendous possibility in the treatment of Diabetes mellitus.

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How to cite this article: Jyotirmay Choudhury, Bishnu Prasad Sarma. A review on antidiabetic property of *Costus Speciosus* (Kemuka). Int J of Allied Med Sci and Clin Res 2016; 4(3): 601-606.

Source of Support: Nil. **Conflict of Interest:** None declared.