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PHARMACOLOGICAL POTENTIALITIES OF *TRICHOSANTHES DIOICA* ROXB. (CUCURBITACEAE): AN OVERVIEW

Subhash C. Mandal^{*1}, Partha Pratim Maiti¹, Anup K. Das¹, Vivekananda Mandal² and Subhasis Panda³

Pharmacognosy and Phytotherapy Research Laboratory¹, Division of Pharmacognosy, Department of Pharmaceutical Technology, Jadavpur University, Kolkata - 700032, West Bengal, India.

Department of Pharmacy, Guru Ghasidasi University², Bilaspur - 495009, Chhattisgarh, India.

Department of Botany, Darjeeling Government College³, Darjeeling - 734104, West Bengal, India.

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Correspondence to Author:

Subhash C. Mandal

Pharmacognosy and Phytotherapy
Research Laboratory, Division of
Pharmacognosy, Department of
Pharmaceutical Technology, Jadavpur
University, Kolkata - 700032, West
Bengal India.

E-mail: parthahpi@gmail.com

ABSTRACT: The genus *Trichosanthes* L. of the family Cucurbitaceae is an annual or perennial herb distributed in tropical Asia and Australia. Pointed gourd (*Trichosanthes dioica* Roxb.) is known by a common name of parwal and is cultivated mainly as a vegetable. The herb has been used for overcoming problems like constipation, fever, skin infection, wounds, etc. According to Ayurveda, leaves of the plant are used as antipyretic, diuretic, cardiostimulant, laxative, antiulcer, etc. The present review describes the morphological and pharmacological aspects of *T. dioica* and summarizes the most interesting findings obtained in the preclinical research related to the plant.

INTRODUCTION: According to the WHO, “herbal medicine is the most lucrative type of traditional medicine which generates billions of dollars regarding revenue annually.” The WHO states that “traditional medicine can treat various infectious and chronic conditions: new anti-malarial drugs were developed from the discovery of Cinchona, a plant used in China for almost 2000 years¹”. The plants in the family Cucurbitaceae are composed of about 122 genera and 940 species (Mabberley, 2008) worldwide, although, the genus *Trichosanthes* has about 100 species (Mabberley, 2008) distributed from Indo-Malayan region to Pacific islands.

The most important genera are *Cucurbita*, *Cucumis*, *Ecballium*, *Citrullus*, *Luffa*, *Bryonia*, *Momordica*, *Trichosanthes*, etc. (more than 30 species in India)². At least 25% of all modern medicines are derived directly or indirectly from medicinal plants, primarily through the application of modern technology to traditional knowledge. The demand for medicinal plants is increasing day by day in both developing as well as developed countries as a result of lacking side effects and easy availability of many herbal drugs.

Occasionally, the medicinal plants are collected as raw from the wild. The therapeutic potential of various herbal plants has required to be explored for its medicinal use. The Indian subcontinent represents one of the richest hotspots of genetic resources. Of the estimated 250,000 species of flowering plants at the global level, about 3000 are regarded as a food source, out of which only 200 species have been domesticated.

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Global diversity in vegetable crops is estimated to be about 400 species of which about 80 species of major and minor vegetables are reported to have originated in India. However, with the advent of cut and burn agriculture, green revolution/commercialized agriculture, the area development projects and the related activities of these diverse resources are declining at a faster rate.

Overgrazing, deforestation, and overexploitation of native resources under range situations have eroded the biodiversity from this unique ecosystem. Moreover, our traditional knowledge about these important indigenous plant species has also decreased in the younger generation influenced by urbanization. Indigenous plant species provide a variety of products like food, medicines, raw materials and are also an important source of renewable energy. The Indian subcontinent had been endowed with about 2500 plant species used in the indigenous treatment and food sources³.



FIG. 1: FRUITING TWIG OF *TRICHOSANTHES DIOICA*

Botany: The plant is a perennial and dioecious vine
Fig. 1. Roots are tuberous with long taproot system. Vines are pencil thick in size with dark green cordate simple leaves. Flowers are tubular white with 16-19 days initiation to anthesis time for pistillate flowers and 10-14 days for staminate flowers.

Botanical Classification of *Trichosanthes Dioica* Roxb.:

Botanical Name : *Trichosanthes dioica* Roxb.
 Common Name : Pointed Gourd, Parwal
 Kingdom : Plantae

Division : Magnoliophyta
 Class : Magnoliopsida
 Order : Cucurbitales
 Family : Cucurbitaceae
 Genus : *Trichosanthes*
 Species : *dioica*

Vernacular Names:

Hindi : Parwal, Parvar, Palval
 Mar : Parwal
 Bengali : Patol
 Gujarati : Potala, Patal.
 Kannad : Kadupodavalu, Kaadu-padavala.
 Malyalam : Patolam, Kattupatolam
 Punjabi : Palwal, Parwal.
 Tamil : Peyu-padal, Kombu-pudalai
 Telugu : Adavi-patola, Kommupotla
 Kon : Kadupaddoola
 Oriya : Patal

Ethnopharmacological Uses: The name of parwal knows pointed gourd (*Trichosanthes dioica*), palwal, parmal, patol, potala in different parts of India and Bangladesh and is one of the important vegetables of these regions⁵. The fruits and leaves are the edible parts of the plant which are cooked in various ways either alone or in combination with other vegetables or meats⁶. Juice of leaves of *T. dioica* is used as a tonic, febrifuge & in subacute cases of enlargement of liver & spleen⁷. In Charaka Samhitha, leaves & fruits used for treating alcoholism & jaundice. Leaves are used in edema and alopecia⁸. It is also used as an antipyretic, diuretic, cardiotoxic & laxative.

Morphology: The plant is a perennial and vine
Fig. 1. Vines are pencil thick in size with dark green cordate, ovate, oblong, entire and rigid leaves. Roots are tuberous with the long tap root system. Flowers are tubular white. Stigma remains viable for approximately 14 h and 40-70% of flowers set fruit. Based on shape, size, and striation, fruits can be grouped into 4 categories⁶.

- Long, dark green with white stripes, 10-13 cm long
- Thick, dark green with very pale green stripes, 10-16 cm long
- Roundish, dark green with white stripe, 5-8 cm long
- Tapering, green and striped, 5-8 cm long.

Cultivation: The pointed gourd is usually propagated through vine cuttings and root suckers. Seeds are not used in planting because of poor germination and inability to determine the sex of plants before flowering.

As a result, crop established from seed may contain 50% nonfruiting male plants. Both are rooted and fresh vine cuttings are used for propagation. Vine cuttings are made in the fall of the previous year and rooted during winter. Fresh vines used for field planting should have 8–10 nodes per cutting. The

distance between plants is kept between 1.5-2.0 m × 1.5-2.0 m. A female: male ratio of 9:1 is optimum for ensuring maximum fruit set⁹.

Chemical Constituents: Early chemical study reveals that in addition to a number of tetra & pentacyclic triterpenes, the toxic, bitter principles cucurbitacins (a group of often highly oxygenated tetracyclic compounds with a unique carbon skeleton & almost a carbonyl group in ring C) may be considered as a taxonomic character of Cucurbitaceae **Fig. 2, 3, 4, 5.**

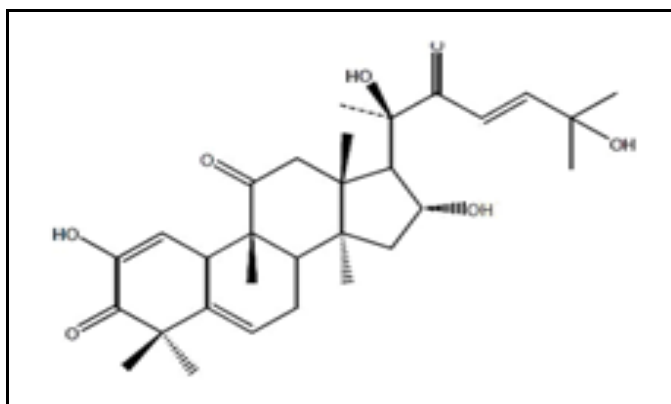


FIG. 2: CUCURBITACIN-J
(MOLECULAR FORMULA-(C₃₀H₄₂O₇))

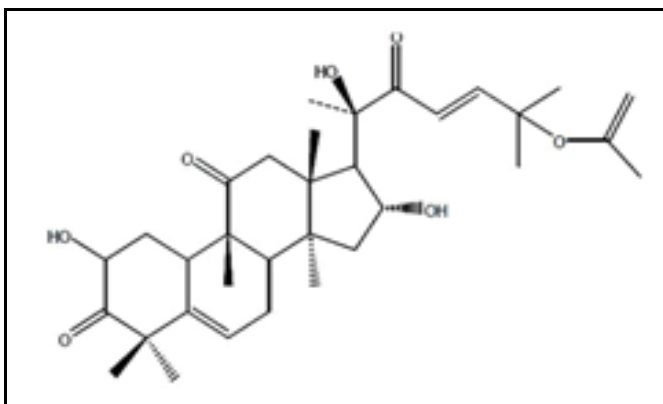


FIG. 3: CUCURBITACIN-B
(MOLECULAR FORMULA- C₃₂H₄₆O₈)

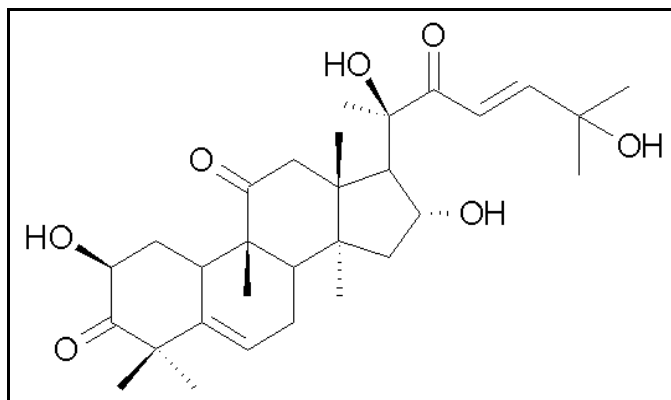


FIG. 4: CUCURBITACIN-D
(MOLECULAR FORMULA-(C₃₀H₄₄O₇))

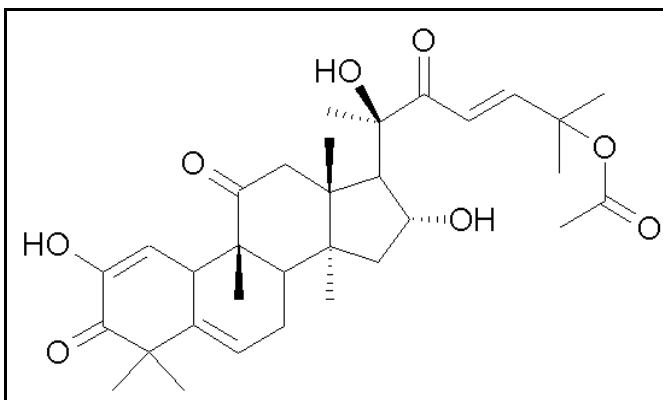


FIG. 5: CUCURBITACIN-E
(MOLECULAR FORMULA- C₃₂H₄₄O₈)

The pointed gourd is rich in vitamins and contains 9.0 mg Mg, 2.6 mg Na, 83.0 mg K, 1.1 mg Cu, and 17.0 mg S per 100g edible part⁴. The seeds of *Trichosanthes dioica* contain a large number of peptides. The seed peptides have the unique property of being resistant to the action of silver nitrate, a sensitive reagent commonly used to stain proteins¹⁰.

The various chemical constituents present in *T. dioica* are vitamin A, vitamin C, tannins, saponins¹¹. Phytochemical evaluations of aqueous and

ethanolic extracts have shown the presence of saponins & tannins¹². The seed extract of *T. dioica* contains 7-oxidihydrokarounidol-3- benzoate as the most predominant component in the highly polar fraction of the nonsaponifiable lipid¹³. Two main phytosterols present in *T. dioica* are namely, 24 α -ethylcholest-7-enol & 24 β - ethylcholest-7-enol¹⁴. Also, seeds of *T. dioica* contain lectin, carbohydrate (specific galactose) binding protein which is homologous to Type-II ribosome inhibitory proteins (Type-II RIP)¹⁵.

Preclinical Studies:

Antidiabetic Activity: Earlier studies showed that glycemic attributes of an aqueous extract of *T. dioica* leave in normal as well as various diabetic models. The variable doses of 250, 500, and 750 mg kg⁻¹ body weight of the extract were administered orally to normal and streptozotocin (STZ) induced sub and mild diabetic rats to define its glycemic potential. This evidence indicates that the aqueous extract of *T. dioica* leaves has good hypoglycaemic potential along with a high antidiabetic profile¹⁶. It had been showed that in rats with streptozotocin-induced severe diabetes mellitus, aqueous extract of *T. dioica* fruits dose of 1000 mg/kg body weight daily once for 28 days reduced the levels of fasting blood glucose, postprandial glucose, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, creatinine, urine sugar and urine protein whereas total protein and body weight was increased. No toxic effect was observed during LD₅₀.

This study suggests that further detailed toxicity studies and mechanism of action of *T. dioica* would be useful for undertaking human trials¹⁷. It was also reported that pointed gourd possesses the medicinal property of lowering blood sugar level in rats¹⁸.

Gastric Antiulcer Activity: The Aqueous extract of leaves of *Trichosanthes dioica* was evaluated for its antiulcer activity against; 1) Aspirin plus pylorus ligation model and, 2) Ethanol/HCl-induced ulcer in Wistar rats. Ranitidine (100 mg/kg) was used as the standard drug. Different groups of rats (n=6 in each group) were given two doses (250 and 500 mg/kg) of *T. dioica* extract. Phytochemical analysis of the extract was also done. Phytochemical results revealed the presence of tannins, saponins, triterpenoids, flavonoids.

Thus, only *T. dioica* extract (500 mg/kg) significantly (p<0.001) reduced the ulcer index in all the models used. The extract also significantly (p<0.001) increased the pH of gastric acid while at the same time reduced the volume of gastric juice, free and total acidities. Also, it showed significant (p<0.05) reduction in pepsin activity. In conclusion, the present study provides preliminary data on the antiulcer potential of *Trichosanthes dioica* leaves and supports the traditional use of the plant for the treatment of gastric ulcer¹⁹.

Cholesterol-Lowering Activity: This study was to examine the effects of single and repeated oral administration of the aqueous fruit extract of *T. dioica* at a dose of 50 ml/kg b.w in normal and streptozotocin-induced diabetic rats. The aqueous fruit extracts of *T. dioica* (50 ml/kg) were administered orally for 15 days, to normal and diabetic rats. The effect of the fruit extracts on cholesterol and triglycerides were studied. The body weights of the rats were observed. The effect of the fruit extract was compared with vanadate, are reference drug. In normal rats, the aqueous fruit extract of *T. dioica* induced a significant decrease of plasma cholesterol and triglyceride concentrations 6 h after a single oral administration, and also in 2 weeks after repeated oral administrations. *T. dioica* treatment caused a significant decrease in plasma cholesterol levels after a single administration and after repeated oral administrations. Significant increase of triglyceride levels was observed 6 h after a single oral administration of the *T. dioica* aqueous fruit extract.

One week after repeated oral administration of aqueous extract of *T. dioica*, the plasma triglyceride levels were significantly decreased. The decreasing trend continued even after 2 weeks. On the other hand, repeated oral administration of *T. dioica* aqueous fruit extract caused a significant decrease of body weight after 2 weeks of treatment in both normal and diabetic rats. The study indicated that the aqueous fruit extract of *T. dioica* exhibits cholesterol and body weight-lowering activities in both normal and hyperglycemic rats²⁰.

Anti-Oxidant Activity: The antioxidant activity of fruits of *Trichosanthes dioica* (Cucurbitaceae) and compared with ascorbic acid (Standard). Materials and Methods: Anti-oxidant activity of aqueous extract of *Trichosanthes dioica* (TSD) fruits was studied for its free radical scavenging property in different *in-vitro* methods as 1, 1 diphenyl-2-picrylhydrazyl, DPPH assay, nitric oxide, reducing power assay and hydrogen peroxide radical method. The findings could justify the inclusion of this plant in the management of antioxidant activity^{21, 22}.

Hepatoprotective Activity: The study was carried out to assess the potential of *T. dioica* as a hepatoprotective agent in ferrous sulphate (FeSO₄)

intoxicated rats. Liver damage was induced in Wistar rats by administering ferrous sulphate (30 mg/kg, p.o) on the 10th day. Ethanolic and Aqueous extracts of TD at different doses (100, 200 and 400 mg/kg) and silymarin (100 mg/kg) were administered orally for 10 days. *T. dioica* at a dose of 200 mg/kg showed a decrease in the levels of AST, ALT, TB, ALP and increased in TP.

The groups treated with 400 mg/kg aqueous and ethanolic extract showed a significant reduction in AST, ALT, ALP, TB and increased in TP level. The pretreatment with *T. dioica* extracts showed profound histopathological protection to liver cells as evident from histopathological studies. Carbon tetrachloride induced hepatotoxicity, Assay of serum GOT, and GPT activities and Assay of serum bilirubin and serum alkaline phosphatase methods are used²³. Hence, it can be concluded that *T. dioica* has significant hepatoprotective activity²⁴.

Burns and Wound Healing: The methanolic extract of the *T. dioica* was selected for assessment of healing potential in the form of simple ointment using full thickness burn wound model in rats. The effect produced by the extract ointment showed significant healing when compared with the control and standard groups. All parameters such as wound contraction, epithelialization period, hydroxyproline content, and histopathological studies were observed significantly in comparison to control group²⁵.

Anti-Inflammatory Activity: Anti-inflammatory activity of polyherbal formulation "Jatyadi Ghrita," the ingredients of Jatyadi Ghrita are *Jasmine Officinale*, *Azadirachta indica*, *Berberis aristata*, *Curcuma longa*, *Picrorrhiza kurroa*, *Rubia cordifolia*, *Trichosanthes dioica*, *Aristolochia indica*, *Hemidesmus indicus*, *Randia spinosa*, *Glycyrrhiza glabra* and Cow's ghee²⁶. *Trichosanthes dioica* (TSD) was studied for anti-inflammatory activity in different *in-vivo* methods as Carrageenin-induced rat paw edema and acetic acid-induced vascular permeability in rats²⁷.

Blood Sugar, Serum Lipids, Lipoproteins, and Faecal Sterols: Effect of oral administration of 2 ml per day of suspension (in water) of alcoholic extract of whole fruit of *T. dioica* (2%) (= 100 g fresh wt. = 7 g dry wt. = 1/15 g of alcoholic

extract) with the help of catheter along with basal diet for four weeks have been studied in the normal albino rabbits. It was observed that this extract lowered the blood sugar, total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels, and increased the high-density lipoprotein cholesterol, phospholipid and fecal sterol levels. Such effects are manifested from the very first week of feeding and are statistically significant²⁸.

Skin Disorder: The polyherbal formulation including *T. dioica* is useful in skin disorder. Fifty cases of various skin diseases were treated with a decoction of a mixture of *Trichosanthes* & other herbal crude drugs in a dose of 20 ml to 40 ml empty stomach with hot water & honey for 4 to 6 weeks. The drug was found to be useful, and no side effect was observed²⁹.

Anthelmintic: The *in-vitro* activities of defatted methanol (MeOH) extract of the leaves from *Trichosanthes dioica* Roxb. (Cucurbitaceae) and its ethyl acetate (EtOAc) and *n*-butanol (*n*-BuOH) fractions were evaluated against *Pheretima Posthuma* (Annelid) and *Ascaridia galli* (Nematode). All the extracts demonstrated concentration-dependent paralytic and lethal effects on *P. posthuma* and lethal effects on *A. galli*. The EtOAc fraction was found to be the most potent followed by the defatted MeOH extract and its *n*-BuOH fraction. *A. galli* was found to be more sensitive than *P. posthuma* against all tests extracts indicating *T. dioica* as an effective nematocide³⁰.

Current Findings: Very recently, a study was reported on antidiarrhoeal activity of *T. dioica*³¹. The inhibition of characteristic diarrhoeal droppings was recorded in magnesium sulfate-induced diarrhea as well as castor oil-induced diarrhea. The extracts at a dose of 200 mg/kg and 400 mg/kg were found to reduce the total number of feces significantly.

It was postulated that effect was due to their action on the secretion/absorption process in the biological system. Ricinoleic acid, the active constituents of castor oil has been reported to reduce active Na⁺ and K⁺ absorption and decrease Na⁺, K⁺ ATPase activity in the small intestine and colon²⁹. The antidiarrhoeal activity was evident from the reduction of a total number of wet feces in the test groups. Magnesium sulphate has been

reported to induce diarrhea by increasing the volume of intestinal content through prevention of reabsorption of water³⁰.

It has also been demonstrated that it promotes the liberation of cholecystokinin from the duodenal mucosa, which increases the secretion and motility of small intestine and thereby prevents the reabsorption of sodium chloride and water^{31, 32}. The ethyl acetate, methanol, and water extracts were also found to alleviate the diarrhoeic condition. Besides, the antidiarrhoeal activity of flavonoids has already been ascribed to their ability to inhibit intestinal motility and hydro-electrolytic secretion, which are known to be altered in this intestinal condition³³. Also, flavonoids will be responsible for the inhibitory effects exerted upon several enzymes including those involved in the arachidonic acid metabolism³⁴. It is possible that the flavonoids present in the herb along with different phytoconstituents are responsible for its antisecretory and antioxidant properties which may contribute to the observed antidiarrhoeal effect. One latest study reported the hepatoprotective effect of the herb in paracetamol-induced hepatotoxicity³⁵.

As the herb is rich in protein and vitamin A, vitamin C, carotene, tannins, and saponins, it possesses antioxidant activity responsible for above mentioned beneficial effect^{36, 37}. Beta carotene and other carotenes have antioxidant properties in vitro and *in-vivo* models³⁸. The levels of vitamin C and E were significantly depleted in paracetamol intoxication which was said to be due to excessive utilization of quenching the enormous free radicals produced during paracetamol intoxication.

CONCLUSION: The species *Trichosanthes dioica* is an easily available and well-known plant used in Indian system of medicine. Also, fruits of *T. dioica* are cultivated in India, Japan, Sri Lanka, China, and Thailand. The fruits, being an integral part of an average Indian diet, are consumed as a vegetable.

Hence, it would not be wrong to state that still a lot has to be worked upon this important plant. Apart from this, old traditional literature like Charak Samhita mentioned the protective role of *Trichosanthes dioica* on important body organs like liver, spleen, etc., many of which are now scientifically proved.

Trichosanthes dioica may play a significant role in developing formulations for geriatric care as it contains almost all the properties of pharmaceutical care designed for the elderly, *i.e.* antioxidant property, antidiabetic property, cholesterol lowering and hepatoprotective, etc. Numerous studies on the herb show that *T. dioica* is a potential herb with a wide range of therapeutic actions. It would be fruitful to investigate further, the specific active constituents in the plant responsible for its therapeutic actions. Also, along with its varied pharmacological actions, it is imperative to study the herb-drug and herb-herb interaction with *T. dioica*, for it may exist and have serious consequences.

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