

AN UPDATED REVIEW ON *TRICOSANTHES CUCUMERINA* L

*Sandhya S, Vinod K.R, J. Chandra Sekhar, R Aradhana, Vamshi Sarath Nath

Department of Pharmacognosy, Nalanda college of Pharmacy, Nalgonda (dt), AP, India - 508001

*Email: sanpharm@gmail.com

ABSTRACT

The universal role of plants in the treatment of diseases is established by their employment in all important systems of medicine. There are many herbs on earth which lies unexplored in the field of medicine or Science. One such plant is *Trichosanthes cucumerina* which is known as snake gourd, viper gourd, snake tomato or long tomato. The fruit is usually consumed as a vegetable due to its good nutritional value. The plant is rich in flavonoids, carotenoids and phenolic compounds. *Trichosanthes cucumerina* has a promising place in the Ayurvedic and Siddha system of medicine due to its various medicinal values like antidiabetic, hepatoprotective, cytotoxic, anti-inflammatory, larvicidal effects. In the present review the complete update on the plant has been enlightened to bring out the hidden medicinal values of the plant.

Key Words: *Trichosanthes cucumerina*, cucurbitacin, hydragogue, hemagglutinant, anti-ovulatory.

INTRODUCTION

A complete understanding of medicinal plants involves a number of factors like botany, chemistry, genetics, quality control and pharmacology. In addition there is a large wealth of knowledge in the medicinal and other properties of plants from generation to generation by the tribal societies¹. *Trichosanthes cucumerina* is a well known plant, the fruit of which is mainly consumed as a vegetable. It is an annual climber belonging to the family Cucurbitaceae. It is commonly called as snake gourd, viper gourd, snake tomato or long tomato. The fruit is usually consumed as a vegetable due to its good nutritional value. The plant is richly constituted with a series of chemical constituents like flavonoids, carotenoids, phenolic acids which makes the plant pharmacologically and therapeutically active. It has a prominent place in alternative systems of medicine like Ayurveda and Siddha due to its various pharmacological activities like antidiabetic, hepatoprotective, cytotoxic, anti-inflammatory, larvicidal effects.²

Trichosanthes cucumerina falls under the scientific classification of

Kingdom: Plantae

Division: Magnoliophyta

Class: Mangnoliopsida

Order: Curcubitales

Family: Curcubitaceae

Genus: Trichosanthes

Species: Cucumerina

The regional names of snake gourd or snake tomato is called in Bengali as Chichinga/ Chichinge, in Telugu as potlakaaya, in Tamil as pudalankaai, in Kannada as aduvalakaayi, in Malayalam as padavalanga, Galartori in Punjabi, padavali in Gujarathi, Chachinda in Hindi.^{3,4}

In other nations it is commonly called as serpent végétal in France, Schlangengurke in Germany, Karasu-uri-zoku in Japan, Patola in Srilanka, Zucchetta cinese in Italy,

Abóbora-serpente in Portugal, Käärmekurkku in Finland, Buap nguu Ma noi in Thailand, Yilan kabagi in Turkey, Calabaza anguina in Spain.

Description

Trichosanthes cucumerina is a monoecious annual herb climbing by 2–3-branched tendrils upto 5 to 6 meters high or less. The stems are slender, green, 4-angled, somewhat hairy, and faintly disagreeable in odor. The roots are somewhat tuberous and whitish. The leaves are alternate, simple with no stipules. Leaves are scabrid hairy on both surfaces, rounded in outline, 7 to 14 centimeters long and broad, and 3 or 5-lobed, the lobes being broad, rounded or obtuse, and the sinuses broad or narrow and rounded. The base is broadly heart-shaped.² The staminate inflorescences are long-peduncled and axillary, with six to fifteen flowers. Flowers are unisexual, regular, and white in colour with green and hairy calyx. Corolla is tubular in with lobes fringed and hairlike outgrowths. The male flowers are many-flowered with axillary racemes on 10–30 cm long peduncles. They are with 3 stamens but the female flowers are solitary and sessile with inferior, single celled ovary, long and with hairy stigmas. Fruits are very slender, long and cylindrical berry, often twisted, greenish-white when immature, dark red when mature. The seeds are half-ellipsoid, somewhat compressed, undulate, hard, rugose, nearly one centimeter long, greyish-brown, sculptured, margin undulate and imbedded in a soft foetid with red pulp.⁵

Origin and distribution

The genus *Trichosanthes* is native to Southern and Eastern Asia, Australia and Islands of the western Pacific. *Trichosanthes cucumerina* is found wild throughout these areas. It was probably domesticated in ancient times in India.² It is grown as a minor vegetable in many countries of tropical Asia. It is locally grown as a vegetable in home gardens in Africa. Commercial growers around big cities in East Africa occasionally grow cultivars of snake gourd imported from India for people of Indian origin. It is also reported from India through Malaya to tropical Australia.

Trichosanthes cucumerina is a newly introduced crop of increasing importance in several parts of Africa, including Ghana and Nigeria. The genus *Trichosanthes* comprises about 100 species, of which a few have been domesticated in Asia, snake gourd being the most important. Two varieties are distinguished within *Trichosanthes cucumerina*. They are the wild var. *cucumerina* occurring from India, Sri Lanka and China, through South-East Asia, to northern Australia, and the cultivated var. *anguina* (L.). Only traditional landraces of *Trichosanthes cucumerina* are used in West and Central Africa, whereas improved cultivars from India are grown in East Africa.⁶ It is distributed in temperate Asian regions like China, tropical regions of Bangladesh, India, Nepal, Pakistan Sri Lanka, Myanmar; Vietnam, Indonesia; Malaysia; Philippines, in Australia it is found in Northern Territory, Queensland and in Western Australia.

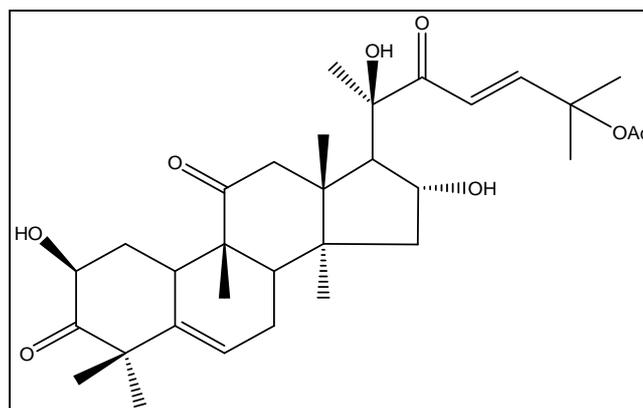
Phytochemicals

Trichosanthes cucumerina is a rich source of nutrition. It is highly constituted with proteins, fat, fibre, carbohydrates, vitamin A and E. The total phenolics and flavonoids content is 46.8% and 78.0% respectively⁷. The fruit is rich in Vitamin C and E. The crude protein content is 30.18%⁸. The predominant mineral elements were potassium (121.60mg 100⁻¹g) and phosphorus (135.0mg 100⁻¹g). Other elements found in fairly high amounts are Sodium, Magnesium and Zinc⁹.

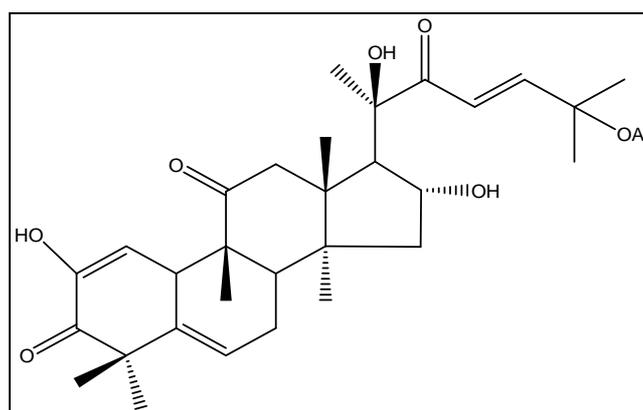
The triterpenes found are 23, 24-dihydrocucurbitacin D, 23,24-dihydrocucurbitacin B, cucurbitacin B, 3 β -hydroxy-olean-13(18)-en-28-oic acid, 3-oxo-olean-13(18)-en-30-oic acid and the sterol 3-O- β -D-glucopyranosyl-24 ξ -ethyl-cholest-7,22-dien-3 β -ol.¹⁰ The percentage free fatty acid and acid values were low suggesting increased stability and usefulness in nutritional and industrial applications¹⁰.

The chemical constituents present in *T.cucumerina* are cucurbitacin B, cucurbitacin E, isocucurbitacin B, 23,24-dihydroisocucurbitacin B, 23,24-dihydrocucurbitacin E, sterols 2 β -sitosterol stigmasterol¹¹. Low amount of chemical substances like oxalate, phytates and tannins are also present. Analysis showed that the seed of *T. cucumerina* have high oil content up to 42.5 \pm 5%. The presence of common protein bands among the species may be an evidence of evolutionary origin and many protein bands found to be unique in the *Trichosanthes cucumerina* suggested that there is no genetic relationship with *Lycopersicon*¹².

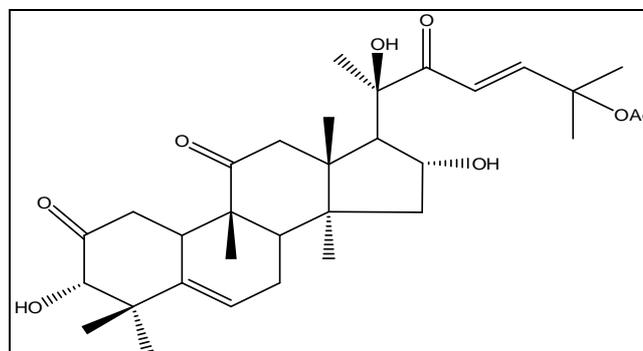
A galactose-specific lectin and ribosome-inactivating protein named trichoanguin¹³ are present in aerial parts^{14,15}. The bulk of carotenoids made of lutein is present in the concentration of 15.6 -18.4 mg/100g FW¹⁵. Circular dichroism spectroscopic studies reveal that TCSL contains about 28.4% beta-sheet, 10.6% beta-turns, 7% polyproline type 2 structure, with the remainder comprising unordered structure; the alpha-helix content is negligible.^{16,17} The α -carotene contents were 10.3 - 10.7 mg/100g FW and the β -carotene contents were found to be 2.4 - 2.8 mg/100g. The ascorbic acid content found was 24.8 – 25.7 mg/100g fresh weight and lycopene content was 16.0 and 18.1 mg/100g FW.



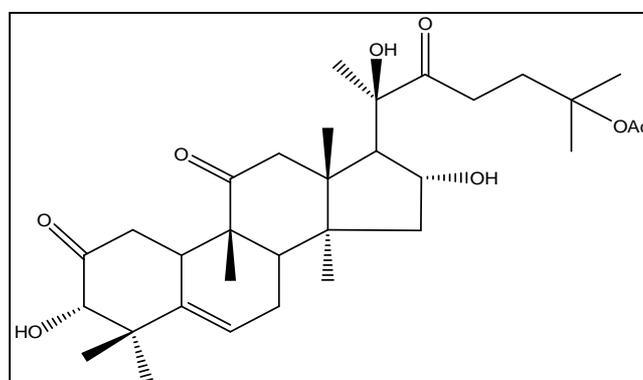
Cucurbitacin B



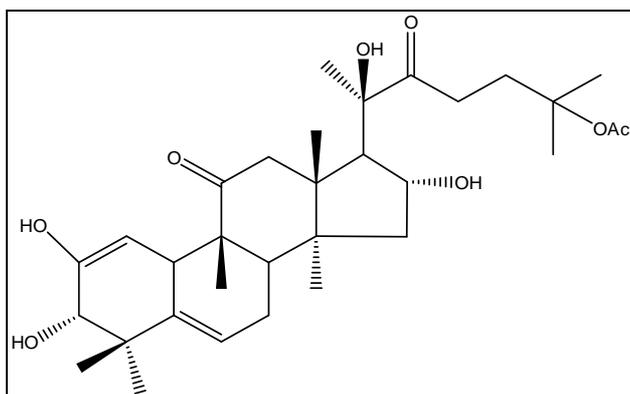
Cucurbitacin E



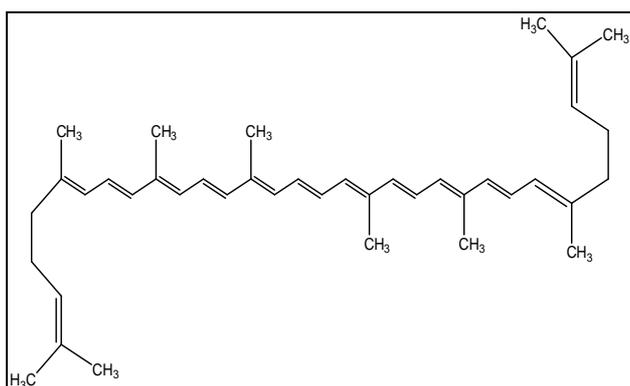
Isocucurbitacin B



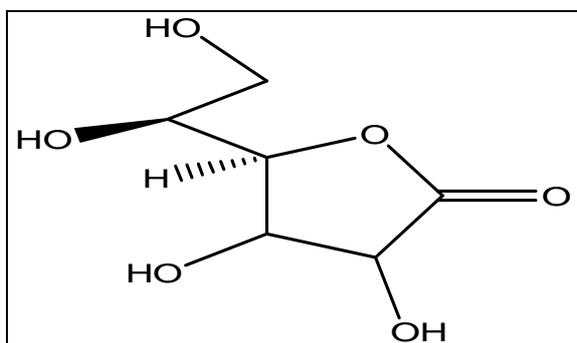
23, 24-dihydroisocucurbitacin B



23, 24-dihydrocucurbitacin E



Lycopene



Ascorbic acid

Chemical constituents

Chemical modifications carried out with imidazole side chains of histidine residues with ethoxyformic anhydride on the galactose-specific lectin (SGSL) purified from snake gourd. *Trichosanthes* seeds indicated that the loss of activity upon modification was not due to changes in the overall conformation of the lectin^{18, 19}. A novel isoflavone glucoside, 5,6,6'-trimethoxy-3',4'-methylenedioxyisoflavone-7-O-beta-D-(2''-O-p-coumaroyl)glucopyranoside has been characterized from the seeds of *Trichosanthes*²⁰. The positive effects of the plant are due to the carotenoids, flavonoids, lycopene, phenolics and β -carotene present in it²¹.

Tribal uses

Trichosanthes cucumerina is used in the treatment of head ache, alopecia, fever, abdominal tumors, bilious, boils, acute colic, diarrhoea, haematuria and skin allergy. *T. curcuminaria* is used as an abortifacient, vermifuge,

stomachic, refrigerant, purgative, malaria, laxative, hydragogue, hemagglutinant, emetic, cathartic, bronchitis and anthelmintic²².

Root: Two ounces of root juice has a drastic purgative action. Roots are used for expelling worms. In China roots used for diabetes, skin swellings like boils and furuncles. Fresh root has anti-convulsant activity. Bulbous part of the root is used as a hydragogue and cathartic. Root is abortifacient, alexiteric, anthelmintic, anti-septic, astringent, diuretic and emetic.

Leaves: Leaf juice is rubbed over the whole body in remittent fevers. Dried leaf has anti-spasmodic property. An infusion of tender shoots and dried capsules is aperient, and the expressed juice of the leaves is emetic. The leaves and stems are used for bilious disorders and skin diseases and as an emmenagogue. Leaf is alexiteric, astringent, diuretic and emetic.

Fruits: The fruit is considered to be anthelmintic. The dried capsules are given in infusion or in decoction with sugar to assist digestion the fruit a very violent purgative and an efficient emetic.

Seeds: The seed is said to be cooling. The dried seeds are used for its anthelmintic and anti-diarrhoeal properties. Seeds have anti-bacterial, anti-spasmodic, antiperiodic and insecticidal properties. It is used as abortifacient, acrid, aphrodisiac, astringent, bitter, febrifuge, purgative, toxic, trichogenous^{22, 23}.

Established scientific uses

Anti-inflammatory

Kolte RM, *et al* in 1997 with hot aqueous extract of root tubers of *Trichosanthes cucumerina* have investigated against carrageenin induced mouse's hind paw oedema and it exhibited significant anti-inflammatory activity²⁴.

Cytotoxic activity

Kongtun S *et al* in 1999 with the root extract of *Trichosanthes cucumerina* L. and the fruit juice tested cytotoxicity against four human breast cancer cell lines and lung cancer cell lines and one colon cancer cell line. The root extract inhibited more strongly than the fruit juice²⁵.

Hypoglycaemic activity

Kar.A *et al* in 2003 with crude ethanolic extract of *Trichosanthes cucumerina* showed significant blood glucose lowering activity in alloxan diabetic albino rats²⁶.

Larvicidal efficacy

Rahuman.A.A *et al* in 2008 using the acetone extract of leaves of *trichosanthes cucumerina* showed moderate larvicidal effects²⁷.

Anti-diabetic activity

M Arawwawala, *et al* in 2009 using hot water extract of aerial parts of *Trichosanthes cucurmerina* has noted to improve glucose tolerance and tissue glycogen in non insulin dependent diabetes mellitus induced rats. Study showed the drug possess antidiabetic activity with

improvement in oral glucose tolerance and glucose uptake in peripheral tissues^{28,29}.

Hepatoprotective activity

Sathesh Kumar.S, *et al* in 2009 found that the methanolic extract of the whole plant of *Trichosanthes cucumerina* showed good hepatoprotective activity against carbon tetrachloride induced hepatotoxicity³⁰.

Anti-fertility activity

Devendra N. Kage, *et al* in 2009 showed the anti-ovulatory activity of ethanol extract of whole plant of *Trichosanthes cucumerina* L. var. *cucumerina* in female albino rats³¹.

Gastroprotective activity

Arawwawala LD *et al* in 2009 with hot water extract of *Trichosanthes cucumerina*, showed a significant protection against ethanol or indomethacin induced gastric damage increasing the protective mucus layer, decreasing the acidity of the gastric juice and antihistamine activity.³² Dose dependent gastroprotective effects were observed in the alcohol model in terms of the length and number of gastric lesions mediated by alcohol in wistar stain rats³².

ACKNOWLEDGEMENT

The authors are thankful to the Principal and Management of Nalanda College of Pharmacy for providing facilities to utilize the library and internet in the college.

REFERENCES

- Trease and Evans, "Pharmacognosy", Ed.15, W.B Saunders, an imprint of Harcourt publishers limited, London, 2002, 3.
- Indian medicinal plants compendium of 500 species, Orient Longman Pvt. Ltd. Chennai, 2002, 320-322.
- Gildemacher BH, Jansen GJ, Chayamarit K, Plant Resources of South-East Asia No 8. Vegetables, *Trichosanthes* L. In: Siemonsma JS, Kasem P, Pudoc Scientific Publishers, Wageningen, Netherlands. 1993, 271–274.
- Choudhury B, Vegetables, India, The land and the people National Book Trust, New Delhi, India, 1967, 214.
- Kritikar KR, Basu BD, Indian medicinal plants, Vol II, International book distributors, New Delhi, 2006, 1112-1114.
- Khare CP, Indian medicinal plants and illustrated Dictionary Springer Science publishers New Delhi, 2007, 671-672.
- Adebooye OC, Phytoconstituents and anti-oxidant activity of the pulp of snake tomato (*Trichosanthes cucumerina*), African Journal of Traditional, Complimentary and Alternative Medicines, 5 (2), 2008, 173-179.
- Yusuf AA, Folarin OM, Bamiro FO, Chemical composition and functional properties of snake gourd (*Trichosanthes cucumerina*) seed flour, Nigerian Food Journal, 25 (1), 2007, 36-45.
- Ojiako OA, Igwe CU, The Nutritive, Anti-Nutritive and Hepatotoxic Properties of *Trichosanthes anguina* (Snake Tomato) Fruits from Nigeria, Pakistan Journal of Nutrition, 7 (1), 2008, 85-89.
- Jiratchariyakul W, Frahm AW, Cucurbitacin B and dihydrocucurbitacin B from *Trichosanthes cucumerina*, J. Pharm. Sci., 19 (5), 1992, 12.
- Datta, SK, Fatty acid composition in developing seeds of *Trichosanthes cucumerina* L, Biological Memoirs, 13(1), 1987, 69-72.
- Ekam VS, Evaluation and characterization of the seed oils of *Trichosanthes cucumerina* (snake gourd) and *Ricinodendron heudelotii* (honey plum), Global Journal of Pure and Applied Sciences, 2, 2003, 9.
- Azeez MA, Morakinyo JA, Electrophoretic characterization of crude leaf proteins in *Lycopersicon* and *Trichosanthes* cultivars, African Journal of Biotechnology 3(11), 2004, 585-587.
- Chow LP, Chou MH, Ho CY, Chuang CC, Pan FM, Wu SH, Lin JY, Purification, characterization and molecular cloning of trichoanguin, a novel type I ribosome inactivating protein from the seeds of *Trichosanthes anguina*, Biochemical Journal 338, 1999, 211–219.
- Anuradha P, Bhide SV, An isolectin complex from *Trichosanthes anguina* seeds, Phytochemistry, 52(5), 1999, 751-8.
- Padma P, Komath SS, et al, Purification in high yield and characterization of a new galactose-specific lectin from the seeds of *Trichosanthes cucumerina*, Phytochemistry Oxford, 50(3), 1999, 363-371.
- Kenoth R, Komath SS, Swamy MJ, Physicochemical and saccharide-binding studies on the galactose-specific seed lectin from *Trichosanthes cucumerina*, Arch Biochem Biophys, 413 (1), 2003, 131-8.
- www.scisoc.or.th/stt/32/sec-c/paper/stt32-c3-c025/pdf, Chanchai Sardseangjun. "Chemical compositions and pharmacological properties of *Trichosanthes cucumerina* L root." Masters thesis (pharmacy) Faculty of graduate studies, Mahidol University, 1993.
- Swamy MJ, Komath SS, Nadimpalli SK, Identification of histidine residues in the sugar binding site of snake gourd (*Trichosanthes anguina*) seed lectin, Biochem Mol Biol Int, 44(1), 1998, 107-16.
- Yadava RN, Syeda Y, An isoflavone glycoside from the seeds of *Trichosanthes anguina*, Phytochemistry, 36(6), 1994, 1519-21.
- Patil AS, Bhole SR, Studies on life history and chemical control of semilooper on snake gourd. Journal of Maharashtra Agricultural Universities, 18(2), 1993, 229-231.

22. Nadkani KM, Indian material medica, Ed.2nd, Vol 1, Popular Prakashan, Mumbai, 2002, 1235-1236.
23. Madhava KC, Sivaji K, Tulasi KR, Flowering Plants of Chittoor Dist A.P. India, Students Offset Printers, Tirupati, 2008, 141.
24. Kolte RM, Bisan VV, Jangde CR, Bhalerao AA, Anti-inflammatory activity of root tubers of *Trichosanthes cucumerina* (LINN) in mouse's hind paw oedema induced by carrageenin, Indian Journal of Indigeneous Medicines, 18(2), 1997, 117-21.
25. Kongtun S, Jiratchariyakul W, Mongkarndi P, Theppeang K, Sethajintanin I, Jaridasem S, Frahm AW. Thai, Cytotoxic properties of root extract and fruit juice of *tricosanthes cucumerina*, J Phytopharm, 6 (2), 1999, 1-9.
26. Kar A, Choudhury BK, Bandyopadhyay NG, Comparative evaluation of hypoglycaemic activity of some Indian plants in alloxan diabetes rats, Journal of Ethnopharmacology, 84(1), 2003, 105-108.
27. Rahuman AA, Venkatesan P, Larvicidal efficacy of five cucurbitaceous plant leaf extracts against mosquito species, Parasitol Res, 103(1), 2008, 133-9.
28. Arawwawala M , Thabrew I , Arambewela L, Antidiabetic activity of *Trichosanthes cucumerina* in normal and streptozotocin-induced diabetic rats; International Journal of Biological and Chemical Sciences, 3(2), 2009, 56.
29. Kirana H, Srinivasan B ,*Tricosanthes cucumerina* improves glucose tolerance and tissue glycogen in non insulin dependant diabetes mellitus induced rats, Indian Journal of Pharmacology, 2008, 345-8.
30. Sathesh KS, Ravi KB, Krishna MG, Hepatoprotective effect of *Tricosanthes cucumerina* L on carbon tetra chloride induced liver damage in rats. J Ethnopharmacol, 123(2), 2009, 347-50.
31. Devendra N, Kage, Vijay KB, Mala S, Effect of ethanol extract of whole plant of *Tricosanthes cucumerina* Var. *Cucumerina* on gonadotropins, ovarian follicular kinetics and estrous cycle for screening of anti fertility activity in albino rats , Int. J. Morphol., 27(1), 2009, 173-182 .
32. www.citeulike.org/article/647498, Arawwawala LD, Thabrew MI, Arambewela LS, Gastroprotective activity of *Trichosanthes cucumerina* in rats, J Ethnopharmacology 2009. doi:10.1016/j.jep. 2009. 11.026.
