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A REVIEW ON THE THERAPEUTIC PROPERTIES OF TRICHOSANTHES CUCUMERINA LINN

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ABSRTRACT

Trichosanthes cucumerina is an annual climber belonging to the family Cucurbitaceae, commonly known as snake gourd, viper gourd, snake tomato, or long tomato. The plant has been used traditionally for getting relief from headache, alopecia, fever, abdominal tumors, bilious, boils, acute colic, diarrhoea, haematuria and skin allergy. T. curcumeria is used as an vermifuge, abortifacient, haem agglutinant, refrigerant, laxative, purgative, emetic, bronchitis, cathartic and anthelmintic. The fruit of the plant is nutritionally rich and is commonly used as a vegetable. The potent pharmacological properties of the plant are mainly due to the presence of flavonoids, carotenoids, phenolic acids, and soluble and insoluble dietary fibers and essential minerals. T. cucumerina is reported to have many biological activities like anti HIV, cardioprotective, anti-ulcer, antidiabetic, hepatoprotective, anti inflammatory and larvicidal effects. The present review is aimed to highlight the various therapeutic properties of the plant in detail.

INTRODUCTION

The significant role of medicinal plants in the treatment of diseases is established years back as they are employed in various systems of medicine. The therapeutic properties of many herbs are yet to be explored to get their benefits . The observations regarding the efficacy of medicinal plants in treating diseases lead to the scientific studies to reveal their therapeutic properties, even though there is no complete knowledge on their chemical

constituents (Silva and Fernandes Júnior, 2010). Trichosanthes cucumerina is such a therapeutically enriched plant, whose fruit is commonly consumed as a vegetable, because of its good nutritional value. The plant is an annual climber belonging to the family Cucurbitaceae(Reddy et al., 2010). It is commonly known as snake gourd, and the other common names include viper gourd, snake tomato, or long tomato in many countries. It is distributed commonly in Asian countries including Sri Lanka, India, Malaysia, Peninsula, and Philippines (Menuka Arawwawala, Thabrew and Arambewela, 2009). The potent therapeutic and pharmacological properties of the plant are mainly due to the rich source of functional constituents like flavonoids, carotenoids, phenolic acids, and solu

ble and insoluble dietary fibers and essential minerals (Yusuf, Folarin and Bamiro, 2007).

Trichosanthes cucumerina (T. cucumerina) is a monoecious annual herb climbing by 2–3-branched tendrils upto 5 to 6 meters high or less. The stems of T. cucumerina are slender, green, 4-angled, somewhat hairy, and faintly disagreeable in odor. The roots are tuberous and whitish. The leaves are alternate, simple with no stipules. The rounded hairy leaves are about 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 almost heart-shaped. 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. Fruits are very long, cylindrica and slender, 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 (Sandhya et al., 2010).

Trichosanthes species plays an important role in the Ayurvedic and Siddha system of medicine due to its various medicinal values like anti HIV, cardioprotective, anti-ulcer, antidiabetic, hepatoprotective, anti inflammatory and larvicidal effects (Rekha et al., 2015). The nutritional composition of T. cucumerina plants includes proteins, fat, fiber, carbohydrates, minerals, and vitamins A and E in significant quantities. The mineral elements predominant are potassium (121.6 mg/100 g) and phosphorus (135 mg/100 g), while sodium, magnesium, and zinc are also present in fairly high amounts (Ojiako and Igwe, 2008). The fruit of this plant improves the appetite as well as acts as a tonic and stomachic and cures biliousness. Many ayurvedic preparations use the wild bitter forms of the plant. The medicinal uses of fruits of cultivated forms are utilised in treating blood pressure, heart diseases, rheumatism and skin allergy (Devi, 2017). T cucumerina is used traditionally for getting relief from headache, alopecia, fever, abdominal tumors, bilious, boils, acute colic, diarrhoea, haematuria and skin allergy. T. curcumineria is used as an abortifacient, vermifuge, refrigerant, purgative, malaria, laxative, hem agglutinant, emetic, cathartic, bronchitis and anthelmintic (Reddy et al., 2010). The whole plant including roots, leaves, fruits, and seeds is reported to show medicinal properties such as antidiabetic, antibacterial, anti-inflammatory, anthelmintic, antifebrile, gastroprotective, and antioxidant activity(Liyanage et al., 2016).

The review aimed to give an update on the therapeutic properties of T. cucumerina plant.

Chemical constituents

A novel isoflavone glycoside has been characterised from the seeds of T. cucumerina, 5,6,6'-trimethoxy-3',4'-methylene-dioxyisoflavone7-O-beta-D-(2"-O-p-coumaroylglucopyranoside) (Yadava and Syeda, 1994). 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 stigmasterol 11 (Azeez and Morakinyo, 2004)(Sandhya et al., 2010) . Low amounts of chemical substances like oxalate, phytates and tannins are also present. The percentage free fatty acid and acid values were low suggesting increased stability and usefulness in nutritional and industrial applications (Datta, 1987). The phytochemical analysis of T cucumerina revealed the presence of alkaloids, flavonoids, phenolics, tannins and terpenoids methanolic extracts of callus and naturally propagated plant, however their levels were higher in wild plant in comparison to callus. (R. et al., 2018). The phytochemical screening of ethanolic extract of seeds showed the presence of triterpenoids, flavonoids and sterols (Gill et al., 2012).

Antioxidant potential

The study by Gill et al., showed the in vitro radical scavenging activity of ethanolic extract of seeds of the plant (Gill et al., 2012). The in vitro and in vivo antioxidant activity of the aqueous and ethanolic extracts of aerial parts of T. cucumerina was studied by Arawwawala et al. the study established the in vitro radical scavenging activity and in vivo antioxidant potential by increasing the activity of antioxidant enzymes and decreasing the lipid peroxidation (Arawwawala, Thabrew and Arambewela, 2011). Monil et al studied and established the in vitro antioxidant activity of petroleum ether and methanolic extracts of T. cucumerina (Momin et al., 2013). Another study was conducted to check the antioxidant activity of the fruits of T cucumerina at different stages of ripening. The study showed that there were decreases in the antioxidant enzymes (superoxide dismutase, ascorbate peroxidase, and glutathione reductase) activities, with the exception of catalase, as ripening progressed in the fruits. These decreased activities may lead to the softening of the fruit during ripening (Badejo, Adebowale and Enujiugha, 2016).

Anti Inflammatory potential

Anti-inflammatory potential of Trichosanthes cucumerina hot water extract (HWE) and its fractions was studied by using carrageenan-induced paw oedema model in Wistar rats. It was found that HWE produced a significant inhibition of the inflammation, peaked after 5h of carrageenan injection. Among the tested fractions of HWE the effect of methanol fraction was comparable to that of the reference drug, indomethacin (Arawwawala et al., 2010). The anti-inflammatory activity of the ethanolic extract of T. cucumerina fruits (TCE) was assessed by human red blood cell membrane

stabilization and inhibition of albumin denaturation. The results showed that TCE inhibited the hypotonicity-induced red blood cell membrane lysis and albumin denaturation, which are the measures of anti-inflammatory activity(Pushparathna et al., 2019). The study done by Despande and seetharam examined the anti inflammatory potential of chloroform and ethanol extract of T cucumerina seeds. Their study established the antiinflammatory potential of both extracts of T. cucumerina seeds (Deshpande and Seetharam, 2010).

Antimicrobial potential

The study by Reddy et al screened the antibacterial activity of various extracts of T. cucumerina leaves, and it was found that the chloroform extract showed potent antibacterial activity (Reddy et al., 2010). Another study tested the antibacterial activity of stem, leaf, flower and seed extracts of Trichosanthes cucumerina L against disease causing bacteria, which revealed that antibacterial activity of stem, leaf, flower and seed extracts of Trichosanthes cucumerina L against disease causing bacteria, in which the seed extracts of T. cucumerina exhibited antibacterial activity against all the bacteria studied (Rudroju et al., 2016). The antibacterial activity of methanolic extracts of callus and naturally propagated plants was screened against various pathogenic bacteria such as Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus. Results indicated that the Gram-positive strain (Staphylococcus aureus) was more sensitive than the Gram-negative bacteria (Escherichia coli and Pseudomonas aeruginosa) and the activity is high for naturally propagated plant extract(Sudha et al., 2018).

Anticancer potential

The methanol extract of polyherbal fraction containing T. cucumerina, Vetiveria zizanioides and Mollugo cerviana in 1:1:1 ratio showed cytotoxicity against HeLa and MCF cell lines. The LC50 value was found to be 467 ± 2.9 µg/ml against the HeLa cell line and >800 µg/ml against MCF-7 cell lines (Devanathadesikan Seshadri et al., 2020). The root extract of T. cucumerina L. and its main constituent, bryonolic acid as well as the fruit juice and its main constituent, cucurbitacin B were tested for cytotoxicity against four human breast cancer cell lines (SKBR3, MCF7, T47D, and MDA-MB435), two lung cancer cell lines (A549 and SK-LU1), and one colon cancer cell line (Caco-2). Both the extract and the compounds showed potent cytotoxicity against the cell lines. The study conducted by Akinsola determined the effect of methanolic extract of T. cucumerina seed on experimentally increased prostate specific antigen in adult male Wistar rats. The study established that the experimentally induced increase in prostate specific antigen was effectively restored by the extract (Akinsola et al., 2012). The antiproliferative activity of cucurbitacin B extracted from T. cucumerina L. was examined on various human cancer cell lines. It was found that the compound exhibits modest direct toxic effect to these cell lines with the highest toxic effect on human colon cancer cells (Kummalue, 2017). Cucurbitacin B (CuB) is one of the potential agents for long term anti cancer chemoprevention (Promkan et al., 2013).

Antidiabetic activity

Studies revealed that T. cucumerina possess antidiabetic activity. A previous study confirmed that aqueous extract of the plant improved the oral glucose tolerance of non insulin dependent diabetes mellitus in rats. Increase in tissue glycogen content indicates the effect of the extract on the uptake of glucose by the peripheral tissues to reduce insulin resistance (Kirana and Srinivasan, 2008). The study by Arawwawala et al revealed the antidiabetic effect of hot water extract of aerial parts of T,. cucumerina possibly through multiple effects involving pancreatic and extra pancreatic mechanisms (M. Arawwawala, Thabrew and Arambewela, 2009). Another study by Kar et al. also confirmed the hypoglycemic effect of T. cucumerina on alloxan induced diabetic rats (Kar, Choudhary and Bandyopadhyay, 2003).

Hepatoprotective effect

Studies have established the hepatoprotective activity of the methanolic extract of the whole plant of T. cucumerina against carbon tetrachloride induced hepatotoxicity in rats. The histopathological changes also confirmed the hepatoprotective activity of the extract (Sathesh Kumar, Ravi Kumar and Krishna Mohan, 2009). The protective effect of mixture of Ethanol extract of T. cucumerina and Coriandrum sativum was studied in paracetamol induced hepatotoxicity in Wistar rats. The results revealed that the combined administration of the extract is more hepatoprotective than the T. cumerina extract alone treatment. (Palanisamy, Shanmugam and Balakrishnan, 2014).

Gastroprotective **effect**

The hot water extract of T. cucumerina is reported to show significant protection against ethanol or indomethacin induced gastric damage. The study proposed that the probable mechanisms by which the extract mediates its gastroprotective action is by increasing the protective mucus layer, decreasing the acidity of the gastric juice and antihistamine activity (Arawwawala, Thabrew and Arambewela, 2010). Previous study by Karunakan et al examined the gastroprotective effect of various fractions of T. cucumerina on ethanol induced ulcer model. The rats treated with the ethyl acetate fraction showed significant reduction in free acidity , total acidity in the gastric juice, increased the amount of mucus produced by the rat gastric mucosa and potent antihistamine activity (Karunakaran et al., 2017). Another study by Palanisamy et al also confirmed the anti ulcer activity of ethanolic extract of T. cucumerina in indomethacin induced ulcer model. The extract showed potent antiulcer activity which was near equivalent to that of standard drug Ranitidine. Histopathological study of the stomach also exhibited almost normal architecture, when compared to Indomethacine treated group (Palanisamy, Shanmugam and Balakrishnan, 2015).

Other miscellaneous activities

The acetone extract of leaves of Trichosanthes cucumerina showed moderate larvicidal effects (Rahuman and Venkatesan, 2008). Another interesting study was done on the effect of aqueous leaf extract on

Trichosanthus cucumerina L. on hair growth promotion in Wistar albino rats. It was observed that extract treated animals showed an increase in the hair growth completion, length of hair, percentage of hair follicles and diameter of bald patch and concentration of minerals in the blood, and are comparable with that of the animals treated with 2% Minoxidil, which is a hair growth promoter. This study reveals that the leaves of T. cucumerina are a potent hair growth promoter which supports the traditional claim (Sandhya et al., 2012). The administration and T. cucumerina fresh juice extract produced significant increase in platelet count and increase in blood parameters like Hemoglobin, total leucocytes count, polymorphs, lymphocytes, eosinophils, monocytes, platelet count and red blood cells count of Rat(Rani et al., no date). The methanolic extract of of fruit of Trichosanthes cucumerina in doxorubicin-induced cardiotoxicity in rats was studied by Shah et al. the pretreatment of the extract reduced the severity of doxorubicin-induced cardiac damage in rats, proving its cardioprotective effect (Shah et al., 2012). The antifungal activity of the stem, leaf, flower and seed extracts was done through a well diffusion method and by measuring the inhibition zone around the disc. The results revealed that the seed extracts of T. cucumerina exhibited antifungal activity against all the tested fungi. Hece the study provided evidence that T. cucumerina can be used as a potential source of antifungal agents (Nanna, Rudroju and Talari, no date). The antiovulatory activity of ethanol extract of the whole plant of Trichosanthes cucumerina L. var. cucumerina was evaluated in adult rats. There observed a normal estrous cycle with a significant increase in estrus and metestrus phases and decrease in diestras and proestrus phases in the extract treated animals. The extract also showed its effect in decreasing the number of healthy follicles and corpora lutea and increased the number of regressing follicles. As well as it caused significant reduction in the activities of 3b-HSD and 17b-HSD in the ovary FSH and LH levels in serum, indicating the antiovulatory activity of the extract (Kage et al., 2009). The study done by Prasanthi and Adikay revealed that hydroalcoholic extract could attenuate the nephrotoxicity in cisplatin induced rats, which provided a strengthened scientific evidence for the use of seeds of T. cucumerina in nephrotoxicity (Prasanthi and Adikay, 2017).

CONCLUSION

Several studies have established the various therapeutic and pharmacological properties of T. cucumerina. Not only the fruit of the plant, which is commonly used as a vegetable, but also the leaves, aerial parts and seeds are also reported to have many therapeutic properties. This review highlighted the antioxidant, antiinflammatory, antimicrobial, anticancer, hepatoprotective, gastroprotective, antidiabetic and other miscellaneous activities of various parts of the plant. The rich content of phytochemicals might be the underlying reason behind the therapeutic potential of the plant. Cucurbitacin B isolated from T. cucumerina is one of the potential agents for long term anti cancer chemoprevention. Likewise, the active principle isolation from the plant can be a source for the treatment of other deadly disorders in future.

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